

# *Proceedings of the West Africa Built Environment Research (WABER) Conference 2010*

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Conference C/o School of Construction Management and Engineering University of Reading PO Box 219 Reading, UK RG6 6AW © The copyright for papers in this publication belongs to the authors of the papers. Correspondence All correspondence relating to the WABER Conference should be addressed to: Dr Samuel Laryea School of Construction Management and Engineering University of Reading, PO Box 219, Reading, UK RG6 6AW Email: [s.laryea@reading.ac.uk](mailto:s.laryea@reading.ac.uk) Declaration All papers in this publication have been through a review process involving initial screening of abstracts, review by at least two referees, reporting of comments to authors, modifications of papers by authors and re-evaluation of re-submitted papers to ensure quality of content.

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**WEST AFRICA BUILT  
ENVIRONMENT RESEARCH  
(WABER) CONFERENCE**

**July 27-28, 2010**

**Accra, Ghana**

**Proceedings of the Waber 2010  
conference**

**Editors**

Dr Samuel Laryea  
Dr Roine Leiringer  
Professor Will Hughes

Proceedings of the West Africa Built Environment Research (WABER) Conference  
Accra, Ghana, 27-28 July 2010

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Dr Roine Leiringer  
Professor Will Hughes

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**Declaration**

All papers in this publication have been through a review process involving initial screening of abstracts, review by at least two referees, reporting of comments to authors, modifications of papers by authors and re-evaluation of re-submitted papers to ensure quality of content.



## FOREWORD

Welcome to this West Africa Built Environment Research (WABER) conference taking place here in Ghana. Thank you for coming and welcome to Accra. The main aims of the WABER conference are: to help young researchers and early-career scholars in West Africa to develop their research work and skills through constructive face-to-face interaction with experienced academics; to provide a platform for networking and collaborative work among senior built environment academics in West Africa; and to serve as a vehicle for developing the field of construction management and economics in Africa.

### Waber 2009

The WABER event in 2009 was held at the British Council in Accra, Ghana on 2-3 June. The event was a resounding success. It attracted participation from 32 researchers, from 12 different institutions, who presented their work to an audience of approximately 100 people. Each presenter received immediate and constructive feedback from an international panel. The event was opened by Professor K.K. Adarkwa, Vice Chancellor of KNUST, Kumasi, Ghana, with several senior academics and researchers from universities, polytechnics, and other institutions in Ghana and Nigeria in attendance. There was also a significant level of attendance by senior construction practitioners in Ghana. Thank you to the School of Construction Management and Engineering, University of Reading, UK for funding the inaugural event in 2009. We are also grateful to all of you who helped to make the event a success and to those of you who have joined us here today to build upon the success and legacy of WABER 2009.

### Waber 2010

This year, we have 60+ peer-reviewed papers and presentations on topics relating to Building services and maintenance, Construction costs, Construction design and technology, Construction education, Construction finance, Construction procurement, Contract administration, Contract management, Contractor development, Decision support systems, Dispute resolution, Economic development, Energy efficiency, Environment and sustainability, Health and safety, Human resources, Information technology, Marketing, Materials science, Organisation strategy and business performance, Productivity, Project management, Quantity surveying, Real estate and planning, Solar energy systems, Supply chain management and Urban development. We hope that these papers will generate interest among delegates and stimulate discussion here and beyond the conference into the wider community of academia and industry.

The delegates at this conference come from 10 different countries. This provides a rich international and multicultural blend and a perfect platform for networking and developing collaborations. This year we are blessed to have three high profile keynote speakers in the persons of Professor George Ofori (National University of Singapore), Dr Roine Leiringer (University of Reading, UK) and Professor Will Hughes (University of Reading, UK). We are also thankful to Dr Chris Harty (University of Reading, UK) who is facilitating the Research Skills Workshop on '*Writing a scientific article*'. Thank you to Dr Sena Agyepong of our conference organising team for her capable management of local organising arrangements. And above all, thank you to all of you for coming to this conference. Enjoy and have a safe journey back home.

Dr Samuel Laryea  
School of Construction Management and Engineering  
University of Reading, July 2010



## **SCIENTIFIC COMMITTEE**

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## LIST OF REVIEWERS

In addition to members of the scientific committee, the following people helped to review abstracts and papers and we would like to acknowledge their contribution and thank them.

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We are grateful to the following academics for leading the refereeing process for papers relating to the research areas designated under their name(s):

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Professor Anny Nathaniel Aniekwu, University of Benin, Nigeria  
Economics and Industry

# PROGRAMME

**TUESDAY 27 JULY 2010**

**08:30-09:00 REGISTRATION**

## **OPENING SESSION (Main auditorium)**

- 09:00-09:10 Welcome address by *Mr. Moses Anibaba* (Director of British Council in Ghana): *The role of the British Council in Africa*
- 09:10-09:15 Introductory remarks by *Professor Will Hughes* (Head of School of Construction Management and Engineering, University of Reading, UK)
- 09:15-09:25 Address by Dr Edward Omane Boamah (Deputy Minister of State, Environment, Science and Technology): *The role of Built Environment academics in Environment, Science and Technology advancement*
- 09:25-09:35 Chairman's remarks by *Professor Kwasi Adarkwa* (Vice Chancellor of Kwame Nkrumah University of Science and Technology, Kumasi, Ghana)
- 09:35-09:45 Official WABER 2010 Group Photograph

## **KEYNOTE ADDRESS (Main auditorium)**

- 10:00-10:30 Built environment education, research and practice: Integrating diverse interests to make an impact  
Professor Will Hughes (Editor-in-chief, *Construction Management and Economics* / School of Construction Management and Engineering, University of Reading, UK)
- 10:30-11:00 Refreshments and networking break

## **PRESENTATION SESSIONS (11:00-13:10)**

### **STREAM 1 (Main auditorium)**

#### **Chairperson Professor Raymond Nkado (University of the Witwatersrand, Johannesburg, South Africa)**

- 11:00-11:10 Construction cash flow prediction model in Ghana: A case study of the district assembly common funded project – Joseph Buerter *et al.*
- 11:10-11:20 Risk and uncertainties in construction clients' cash flow forecast – M.O. Babalola and G.K. Ojo
- 11:20-11:30 Discussion
- 11:30-11:40 Evaluating the characteristics of whole life-cycle cost data in the Nigerian construction industry – A M Ibrahim, K Bala, Y M Ibrahim, A D Ibrahim
- 11:40-11:50 Construction cost data management by quantity surveying firms in Nigeria – Johnson Olubunmi Atinuke
- 11:50-12:00 Discussion

#### **Chairperson Dr Mrs. Bola Babalola (Obafemi Awolowo University, Nigeria)**

- 12:10-12:20 An artificial neural network model for predicting construction cost of institutional building projects in Nigeria – Baba Shehu Waziri
- 12:20-12:30 Multi-criteria decision-making model for contractor's selection in construction projects in Nigeria – Oluwaseyi Modupe Ajayi
- 12:30-12:40 Discussion
- 12:40-12:50 Introduction of build-operate-transfer (BOT) model into main stream funding of infrastructural projects in Ghana – Kwaku Owusu
- 12:50-13:00 Appraisal of factors that influence the implementation of BOT infrastructure projects in Nigeria – Alhassan Dahiru and S. A. Bustani
- 13:00-13:10 Discussion
- 13:10-14:30 Lunch and networking break



## **PRESENTATION SESSIONS (11:00-13:10)**

### **STREAM 2 (Seminar room)**

#### **Chairperson Dr Paul Alagidede (University of Stirling, Scotland, UK)**

- 11:00-11:10 The macroeconomic review of building and construction sector in Nigeria: pre 1980-2006 – Folasade Omoyemi Alabi
- 11:10-11:20 An assessment of the effectiveness and equitability of access to federal mortgage bank of Nigeria's finances for housing (1992 - 2008) – Musa Nuhu Madawaki
- 11:20-11:30 Discussion
- 11:30-11:40 A hedonic regression analysis of urban infrastructure in commercial property values in Lagos – Funlola Famuyiwa
- 11:40-11:50 Analysing quantitative data using factor analysis: reflections from an empirical study – D. K. Ahadzie, D.G. Proverbs and N.A. Ankrah
- 11:50-12:00 Discussion

#### **Chairperson Dr Moshood Olawale Fadeyi (British University in Dubai, UAE)**

- 12:10-12:20 The applicability of the Harvard and Warwick models in the development of human resource management policies of large construction companies in Ghana – Sena Agyepong, Frank Fugar and Martin Tuuli
- 12:20-12:30 Characteristics of migrant labour in Wasimi, Irewole Local Government Area, Osun State, South-western Nigeria – M. B. Gasu and S.O. Fadare
- 12:30-12:40 Discussion
- 12:40-12:50 Land and housing values and their effect on housing delivery in Sekondi-Takoradi metropolis, Ghana – P. P. Yalley, J. F. Cobbinah and P. K. Kwaw
- 12:50-13:00 The influence of facilities on rental values and vacancy rates in high rise office rented properties in Kaduna, Nigeria – David Ayock Ishaya and Daniel Ishaya Dabo
- 13:00-13:10 Discussion
- 13:10-14:30 Lunch and networking break

### **KEYNOTE ADDRESS (Main auditorium)**

- 14:30-15:00 Built environment research and the Millennium Development Goals  
Professor George Ofori (School of Design and Environment, National University of Singapore, Singapore)
- 15:00-15:30 Refreshments and networking break

## **PRESENTATION SESSIONS (15:30-17:40)**

### **STREAM 1 (Main auditorium)**

#### **Chairperson Professor G.W.K. Intsiful (KNUST, Kumasi, Ghana)**

15:30-15:40	Sustainable construction education: assessing the adequacy of built-environment professional's training – S Ameh, A Dania, I Zubairu and S Bustani
15:40-15:50	The role of construction education in sustainable waste material management in the construction industry – Nongiba A. Kheni
15:50-16:00	Discussion
16:00-16:10	Evoking the green-shift in the building industry for sustainable development in Nigeria – Dodo Yakubu Aminu <i>et al.</i>
16:10-16:20	The role of organizational learning in achieving sustainable construction project delivery – Alex Opoku and Chris Fortune
16:20-16:30	Discussion

#### **Chairperson Dr Esi Ansah (Ashesi University, Ghana)**

16:40-16:50	Safety on Ghanaian construction sites: The role of the employer and the employee – B. B. Akomah, A. Nimo-Boakye, F. D. K. Fugar
16:50-17:00	How and to what extent do construction project features contribute to accident causation? – P Manu, N Ankrah, D Proverbs, S Suresh and D Ahadzie
17:00-17:10	Discussion
17:10-17:20	Sustainability of solar home systems for a domestic power supply in Nigeria – Dalhatu Abdulsalam, I. Imbamali and I.K. Zubairu
17:20-17:30	Building integration photovoltaic module with reference to Ghana: using triple-junction amorphous silicon – Emmanuel Adu Essah
17:30-17:40	Discussion

### **STREAM 2 (Seminar room)**

#### **Chairperson Dr Martin M. Tuuli (Loughborough University, UK)**

15:30-15:40	Problem of ready-mix concrete production in the construction industry in Nigeria and its cost implication – Dauda Dahiru
15:40-15:50	The continuous use of asbestos in Ghana despite its hazards (case study area: Sekondi-Takoradi) – P. P. Yalley and C. N. Ndede
15:50-16:00	Discussion
16:00-16:10	Impervious building (coating) materials' workability in South-West Nigeria: a case of Akure, Ondo State – Clement Oluwole Folorunso
16:10-16:20	Investigations into the pozzolanic activities of volcanic deposits from the Jos plateau; interim report on chemical characteristics – D. W. Dadu <i>et al.</i>
16:20-16:30	Discussion

#### **Chairperson Rev. Dr Frank Fugar (KNUST, Kumasi, Ghana)**

16:40-16:50	Effects of flooding on the built environment in Akure, Nigeria – Gabriel Fadaio and Sikiru Abiodun Ganiyu
16:50-17:00	Disaster preparedness of high rise buildings in Lagos metropolitan area: evaluating the risk, vulnerability and response strategies – I H Mshelgaru and O. Olowoyeye
17:00-17:10	Discussion
17:10-17:20	An assessment of the causes of foundation failure in residential buildings – Aliyu Suleiman Shika and Nkeleme Emmanuel Ifeanyi
17:20-17:30	Appraisal of the public private partnership in residential housing delivery for low income group in the north central geo-political zone, Nigeria – Suleiman Bolaji
17:30-17:40	Discussion
17:40	Close

## WEDNESDAY 28 JULY 2010

### RESEARCH SKILLS WORKSHOP

09:00-10:30 Writing a scientific article – Dr Chris Harty (School of Construction Management and Engineering, University of Reading, UK)  
10:30-11:00 Refreshments and networking break

### PRESENTATION SESSIONS (11:00-13:10)

#### STREAM 1 (Main auditorium)

##### Chairperson **Dr Emmanuel Achueni (University of Jos, Nigeria)**

11:00-11:10 Construction project delivery in Ghana: The performance of the traditional procurement method – Collins Ameyaw and S Oteng-Seifah  
11:10-11:20 Towards improving procurement of built infrastructure in Nigeria – Kulomri Jipato Adogbo, Ahmed Doko Ibrahim and Yahaya Makarfi Ibrahim  
11:20-11:30 Discussion  
11:30-11:40 The lean project delivery system (LPDS) – Zoya E. Kpamma and Theophilus Adjei-Kumi  
11:40-11:50 Value management: How adoptable is it in the Nigerian construction industry? – Baba A. Kolo and Ahmed D. Ibrahim  
11:50-12:00 Discussion

##### Chairperson **Professor Kabir Bala (Ahmadu Bello University, Nigeria)**

12:10-12:20 How do clients influence innovations in construction professional services firms? – John Kissi, Robert Payne, Sam Luke, Andrew Dainty and Anita Liu  
12:20-12:30 An exploratory study of the contextual meaning and consequences of empowerment in project teams – Martin M. Tuuli  
12:30-12:40 Discussion  
12:40-12:50 The effects of management on productivity: A comparative study of indigenous and foreign firms in the Nigerian construction industry – A. N. Aniekwu and H.O. Audu  
12:50-13:00 Challenges and opportunities facing contractors in Ghana – Samuel Laryea  
13:00-13:10 Discussion  
13:10-14:30 Lunch and networking break

#### STREAM 2 (Seminar room)

##### Chairperson **Professor Anny Nathaniel Aniekwu (University of Benin, Nigeria)**

11:00-11:10 Adaptable and flexible design solutions for improved functional quality of public apartment buildings in Ghana – Agyefi-Mensah, S., *et al.*  
11:10-11:20 Environmentally responsible interior design (ERID) solutions for air-conditioned office space in Dubai – M O Fadeyi and R Taha  
11:20-11:30 Discussion  
11:30-11:40 A factorial study of accessibility requirements of paraplegics mobility in a built up environment – Ashiedu, Festus and Igboanugo, Anthony Clement  
11:40-11:50 An investigation into the use of unapproved drawings in the construction industry in Ghana – Nanyi Kobina Orgen  
11:50-12:00 Discussion

##### Chairperson **Dr Emmanuel A. Essah (University of Reading, UK)**

12:10-12:20 An evaluation of physical transformation of residential buildings in government estates in south western, Nigeria – Victor Olufemi Adegbehingbe  
12:20-12:30 Emphasizing the need for estate surveyors and valuers' capacity building in housing development in mega city – Kemiki Olurotimi  
12:30-12:40 Discussion  
12:40-12:50 People's attitude toward property tax payment in Minna – Ayoola Adeyosoye Babatunde  
12:50-13:00 Analysis of households' travel behaviour in Lagos metropolis – Wale Alade  
13:00-13:10 Discussion  
13:10-14:30 Lunch and networking break

## KEYNOTE ADDRESS

14:30-15:00	Handmaidens and ivory towers: The role and responsibility of construction management researchers as agents of change Dr Roine Leiringer (School of Construction Management and Engineering, University of Reading, UK)
15:00-15:30	Refreshments and networking break

## PRESENTATION SESSIONS (15:30-17:45)

### STREAM 1 (Main auditorium)

#### Chairperson **Dr Sena Agyepong (KNUST, Kumasi, Ghana)**

15:30-15:40	Cost escalation of major infrastructure projects: A case study of Soccer City Stadium in Johannesburg – Raymond Nkado
15:40-15:50	The evolution of indigenous contractors in Ghana – Samuel Laryea and Sarfo Mensah
15:50-16:00	Discussion
16:00-16:10	An assessment of the effect of community participation on sub-urban development in Akure – Akin, Oluwatoyin .T. and Oyetunji, Abiodun K.
16:10-16:20	Assessment of governmental intervention towards tourism development of Idanre hills, Ondo state, Nigeria – A. J. Afolami and A. A. Taiwo
16:20-16:30	Discussion

#### Chairperson **Dr Nongiba A. Kheni (Tamale Polytechnic, Ghana)**

16:40-16:50	Management of water distribution infrastructure with GIS in the Niger delta region of Nigeria – H. A. P Audu and G. C. Ovuworie
16:50-17:00	Resident's perception of the central sewage system in the federal capital city, Abuja-Nigeria – Andrew Stanley <i>et al.</i>
17:00-17:10	The effect of restructuring the Central Business District (CBD) on urban housing and poverty in Lagos, Nigeria – Paul Obi
17:10-17:25	Discussion
17:25-17:45	Presentation of certificates and close

### STREAM 2 (Seminar room)

#### Chairperson **Dr Peter Yalley (Takoradi Polytechnic, Ghana)**

15:30-15:40	Structural stability in Nigeria and worsening environmental disorder: the way forward – Anthony N. Ede
15:40-15:50	The spatial dynamics of cement manufacturing and marketing in Nigeria – Kemiki Olurotimi
15:50-16:00	Discussion
16:00-16:10	An assessment of core skills and competencies of quantity surveyors in Nigeria – Joshua O. Dada
16:10-16:20	The disproportional representation of black and minority ethnic peoples' (BMEs) employability in construction: a review of literature – Paul Missa and Vian Ahmed
16:20-16:30	Discussion

#### Chairperson **Dr K.T. Odusami (University of Lagos, Nigeria)**

16:40-16:50	Pre-construction information implementation in Ghana using UK's CDM 2007 model – John Dadzie and David Coles
16:50-17:00	Factors affecting the choice of dispute resolution techniques in the Nigerian construction industry – Mustapha AbdulRazaq <i>et al.</i>
17:00-17:10	An assessment of liquidated and ascertained damages in contract delivery – Wasiu Bello
17:10-17:25	Discussion
17:25-17:45	Presentation of certificates and close (Main auditorium)

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## **SECTION 1: KEYNOTES**



# **BUILT ENVIRONMENT EDUCATION, RESEARCH AND PRACTICE: INTEGRATING DIVERSE INTERESTS TO MAKE AN IMPACT**

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The role of the academic in the built environment seems generally to be not well understood or articulated. While this problem is not unique to our field, there are plenty of examples in a wide range of academic disciplines where the academic role has been fully articulated. But built environment academics have tended not to look beyond their own literature and their own vocational context in trying to give meaning to their academic work. The purpose of this keynote presentation is to explore the context of academic work generally and the connections between education, research and practice in the built environment, specifically. By drawing on ideas from the sociology of the professions, the role of universities, and the fundamentals of social science research, a case is made that helps to explain the kind of problems that routinely obstruct academic progress in our field. This discussion reveals that while there are likely to be great weaknesses in much of what is published and taught in the built environment, it is not too great a stretch to provide a more robust understanding and a good basis for developing our field in a way that would enable us collectively to make a major contribution to theory-building, theory-testing and to make a good stab at tackling some of the problems facing society at large. There is no reason to disregard the fundamental academic disciplines that underpin our knowledge of the built environment. If we contextualise our work in these more fundamental disciplines, there is every reason to think that we can have a much greater impact than we have experienced to date.

Keywords: education, practice, research, university, vocation.

## **INTRODUCTION**

The purpose of this keynote presentation is first, to examine how built environment education and research inform each other. Second, it is about how they both inform and are informed by practice. Third, it is about the extent to which these things together can inform not only built environment research and practice, but wider academic disciplines and, perhaps, society as a whole. Built environment is anything that is not the natural environment, and therefore encompasses buildings and infrastructure, in their design, management, operation and disposal.

## **RECONCILING THE IRRECONCILABLE**

To a certain extent, the topic I have chosen involves a fool's errand in attempting to reconcile the irreconcilable. First, it may be stating the obvious to assert that built environment education is about education, but too often it is seen by many people as being about training

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for a vocation. There is a key distinction between education and training. Second, research is often carried out by people who do not teach, as well as by people who are not sufficiently experienced at research to come up with findings that are interesting and useful. Third, practitioners, like many people in society generally, often fail to appreciate the role of the university in society, and therefore get frustrated when their expectations are not met. So, across these three special interests in the built environment, there are hugely mis-matched expectations that lead to a great deal of dissatisfaction and mis-guided effort.

These issues are even more difficult to deal with when they are seen in a wider, societal context. We argue among ourselves about how industry might better support our research, how teaching might meet the needs of industry, why our research does not increase the productivity and efficiency of built environment firms, and so on. While we are arguing about how each can better support the other, no one appears to be thinking about how all of us, collectively, might contribute to society. What is happening in the wider world? What is the context that we seek to relate to in order to make our work more meaningful? There have been several changes in recent years regarding the role of professionals of all kinds, particularly in relation to a general decline in trust. This is important, because academics are professionals, and our particular breed of academics is trying to prepare students for a profession. What does it mean to be a professional? What does society expect from professionals that it would not expect from other kinds of people? And if professionalism is in decline, what should we make of the kind of managerialist and so-called “best practice” ethic that appears to be replacing it? These questions hinge around the role of judgement in decision-making and the relationship between experts and non-experts, generally. In other words, I can see a problem here and I am asking myself my favourite question when it comes to defining a problem – what is the general class of problem of which this is a specific example? And through this question, I hope to comment on what our discipline might be able to share with others, both now and in the future.

## **WHAT IS BUILT ENVIRONMENT EDUCATION FOR?**

Clearly, the primary purpose of built environment education is the preparation of people for a vocation in the built environment. Should the universities be more concerned with the pursuit of knowledge for its own sake? Have we lost touch with our traditions by directing so much of our effort to the service of the vocations? I suspect not. Traditionally, universities have focused on preparation for vocations – for example, by the sixth century in Europe, education only existed where the church maintained it. As Patterson (1997: 31-32) points out in her history of the University since Ancient Greece:

*The church regarded education not as a good in itself, but as a means of training the clergy in the sacred writings and in the performance of their religious duties. Education was therefore restricted within the boundaries of the church's interests and doctrines.*

It is interesting how closely this resonates with a perception that the professions seek to restrict the boundaries of vocational education in the universities, even though most professional institutions, these days, would not seek to have this kind of influence or control. In addition to this view, I would also offer another view, this time from Edward Shils – *Universities have a distinctive task. It is the methodical discovery and the teaching of truths about serious and important things* (Shils 1997: 3).

## **HOW SHOULD RESEARCH BE DESIGNED AND CARRIED OUT?**

Research is a methodical process of discovering new knowledge or facts, and it is usually preferable if these things are interesting or useful. In the built environment, despite the

increasing range of books about built environment research methods, research is still research! There is not a special branch of research methodologies that are exclusive to the built environment. There are many ways of carrying out research, and many of us get terribly confused about what constitutes research. Clearly, it is important to make sure that what we do in the name of research has some meaning and some kind of impact. Two questions about any particular research project flow from this. First, is this the right research method? Second, is the research done well? Apart from the obvious problems of inappropriate methods, one problem that I frequently encounter is poorly designed research. For example, students frequently distribute their survey questionnaires through email lists. Typically, these lists consist of academics from many countries, but usually, the survey questions are based on a set of assumptions that reveal a complete lack of understanding.

One recent survey was an interesting case in point, from an American doctoral student interested in how construction employers deal with the risks associated with terrorism when their professional employees work on overseas projects in trouble spots. His first question, to an international list of construction academics, was: "Have you ever worked on a construction project outside of the United States?" It is clear from the context of this question that he identifies overseas as being outside the United States. But, clearly, if I had never worked overseas, I would have to answer yes to this question, since I only worked on projects at home, in UK. So, having answered yes to this question, because I have worked on projects outside the United States, the next screen asked a whole load of questions with drop-down options that made little sense to me, but clearly made a great deal of sense to the researcher. I particularly wondered about the question "Have you worked in any country which was affected by terrorism?" I guess that the UK has been affected by terrorism – but is this really what the researcher is looking for, given that his next question asks if my family travelled with my while I worked abroad? This was very confusing. Until this point I was answering questions about working on sites in the UK, a country that has been affected by terrorism. But when asked a question about taking my family with me while I worked abroad, I had to think about when my family came with me when I travelled as an academic to countries that were not affected by terrorism. In other words, all of the questions about my working abroad elicited answers that were nothing to do with what the student was investigating. So I aborted the questionnaire half way through. Given what I know about survey questionnaires, I was struck by a series of questions about this research: How do you write up a survey when you have not defined a sampling frame? What would you state about the population, the sample and the return rate? This student clearly had no idea who the survey went to, how many people even looked at it, what to do with the data once collected, or anything meaningful. There is nothing to be learned from this exercise, and what really worries me is that one day the work might turn up in a conference or as a paper submitted to a journal. What will the researcher make of this random set of opinions from a random set of people?

Before sending surveys out to mailing lists, students and researchers should be encouraged to think about the traditional steps in designing surveys. I wonder what we are teaching our students that leads them to make so many errors in the design of a simple survey. One thought that frequently occurs to me is that these construction researchers simply do not realize that they are carrying out social science research. Many people imagine that because they are researching in the construction sector, they are carrying out something other than social science. There are so many good books on this topic, such as Oppenheim (1992), Fink (1995), Converse and Presser (1986), Moser and Kalton (2001), to name but a few, that I sometimes wonder whether research students are being directed to this extensive literature on how to carry out research. Again, I question whether the absence of the word "construction" in these social science research texts makes them invisible to people in our field.

This phenomenon is one of the most frequent problems that I find with papers submitted to *Construction Management and Economics* as well as to papers submitted to numerous conferences with which I am involved. If our researchers are not basing their research design on the literature about research methods, what are they basing it on? There are some reasons to think that the two key influences in much of this work are newspapers and consultants.

The media frequently publish the results of market research and focus group research, most of which is centred on either marketing or politics (is there a difference?). I recall reading one article in a construction magazine that should remain nameless in which the editor was writing about a survey of managers in construction firms. He wrote how 28% agreed that the situation was serious, 54% felt that the government should intervene, 86% thought that they were going to change something about their approach... I soon noticed that every result was a multiple of one seventh (14%). In other words, this fellow had called up seven of his friends and asked them what they thought about a series of issues, then reported the result as if he'd carried out a survey! That was bad enough. But what makes it worse is when other people emulate this, thinking that they are doing a survey. Another common misunderstanding is what is meant by "case study". Again, there is a strong literature about what case studies are, what you can do with them, how you might go about them. It is depressing to have to say that one interview is not a case study! Too often, the views of key respondents are accorded too much significance.

Consultants are widespread in the construction sector. It is what most of our vocational training is preparing people for. And most of the lecturers in our field were (or still are) consultants of one kind or another. To what extent does the education of architects, surveyors and engineers prepare them to carry out or teach research methods? Many of the research projects that we see proposed or discussed at conferences are not research projects at all, but consultancy projects, geared up to do something practical, solve a particular problem of the kind that would normally be dealt with by consultants. By getting universities to carry out this work in the name of research, it is quite possible to get some free or cheap consultancy. I understand how this comes about, but that does not make it research. Simply being a practitioner does not help us to add to the sum total of knowledge about what practitioners do and why they behave in the way that they do. Indeed, I commented on this in feedback about last year's inaugural WABER event, as follows:

First, there was clearly some confusion as to what constituted academic research. Many presenters were clearly setting up a piece of consultancy work. When it was pointed out to them that this was not research and would not satisfy the requirements for a PhD, there was some confusion. In the end, we simplified the message down to "if you are doing what practitioners do, you are doing consultancy. If you are examining or analysing what practitioners do, it is research". This was something that had to be hammered home, but is also a regular problem in CM research the world over. Second, few presenters had come across the idea of research methodology. As usual, the word was bandied around a lot as a heading, but as usual, it heralded a discussion of methods. The distinction between methods and methodology was as difficult to get across here as anywhere. One metaphor that seemed to work was cooking - a recipe is a list of steps that are to be used in preparing a dish, but the recipe does not tell you why these steps work. Such is the difference between explaining what steps were involved (research methods) and explaining why they were chosen and how they generate data and information that will usefully address the questions (research methodology). Another frustration with research methods was the preoccupation with survey questionnaires and the notion of preparing some kind of model. It is a common feature among new researchers to assume that social science research requires a questionnaire survey. It doesn't. There are so many research methods that might be used, and the lack of variety in

approaches to hugely varying questions indicated that few of these researchers were aware of the literature on research methods. So we frequently pushed people to carry out some review of research methods before they did their fieldwork, and in many cases we told them that a questionnaire survey would simply not answer the questions they were asking.

In my opinion, the simple answer to the question about how research should be designed and carried out is that it should be done along the lines of good research practice, rather than along the lines of journalism or consultancy. In other words, there is something known as “academic rigour” that appears to be missing from many of the studies that I see.

## **HOW DO UNIVERSITIES CONTRIBUTE TO INDUSTRY?**

Built environment practice does not, of course, take place in the universities, but in the building industry. In thinking about practice, therefore, the focus must be on the connections between universities and industry. Recently, I have had the experience of being involved with a group of senior practitioners, at a policy-making level, and their reactions to suggestions about what universities might do are generally dismissive and impatient. I have been surprised by the strength of their reactions when I suggest various ways in which universities (not just mine) might be able to help act as a repository of knowledge, a problem-solving resource, some kind of ideas exchange or enabler. These ideas have been dismissed out of hand as being distracting, counter-productive or just plain useless. This has resulted in a few heated discussions, of course. And what we have come down to is that their feeling is that academics typically think of all the reasons why something should not be done, when something definitely needs to be done. Is this a fair assessment? I have noticed that we do spend a lot of time thinking of why something should not be done, or why something is just wrong. I also understand just how important it is for the academic to be sceptical; to doubt everything. Is there some useful ground between academic scepticism and industry pragmatism?

If universities are not contributing to how policy-makers think, then what are we doing? Clearly, there is a very strong expectation from business that we shall continue to prepare people for vocations. In many places, this is becoming almost the only purpose of a university. If a programme of study does not contribute to increased efficiency of some business or other, then, presumably, it has no purpose. Clearly, this is an absurd statement, but it does seem to underline much of the rhetoric we see in the media, especially in the UK when it comes to discussions about the extent to which students should be expected to pay for their own education. There is a strange but somewhat fixed idea in the media that graduates themselves are the only beneficiaries, as if university education provided no benefits to the rest of society. But this has become such a truism for many of us that we may have forgotten how universities contribute to society generally, and how built environment departments contribute to the construction industry specifically. Indeed, some countries are more enlightened than this, and in places like Sweden, for example, university education is free. Presumably, this is not because the Swedish government simply wants to be charitable to bright people, but because they see that there is a benefit to society in having people educated to this level, and in developing the ideas that will continue to fuel the country’s development, in an independent atmosphere.

The question about the contribution of universities to the construction industry is an interesting one, because the study of the built environment, as well as the kind of research that we carry out, is generally not an academic discipline in its own right. Thus, construction practitioners operate at such a practical level, they are successful without theoretical insights. They need to be good at business, and there are plenty of examples of how you do not need to be educated or clever to be good at business. Interestingly, in the health arena, clinical

practitioners have a fundamental need to be up to speed with the latest research from universities. They have a strong obligation to carry out their clinical practice in the light of the most recent thinking and research findings. How much better would our built environment world be if construction practitioners felt that they could not practice effectively without knowing about the latest research findings in our field? Whichever way you look at it, there is a big disconnection between research and practice in the built environment, and that cannot be good for either of us.

In the light of this, I think that there is a problem in deciding what universities can do for industry. If all we are doing is teaching students to be good practitioners, just like the practitioners already out there, then we are destined to destroy the built environment professions by recycling old ideas and preserving outdated practices. In a fast-changing world, we need new ideas from our research that will constantly inform, refresh and change what we teach. The key factor that distinguished universities from teaching colleges is the research that feeds new ideas and knowledge into the syllabus. Graduates enter the industry and (I hope) challenge conventional wisdom, and so we have an influence. More importantly, we should be working closely with clients and contractors, asking searching questions that arise from and contribute to the theoretical frameworks that underpin our practices. Typically, in construction management, these will be social sciences, not engineering sciences. We need constantly to remind ourselves that when we are addressing problems to do with management, economics and law, we are taking a social science standpoint. My vision for the long-term is not just what we can do for construction practice, but the way that we might contribute to new theoretical insights in the social sciences. That would be the ultimate test of our ideas, I feel.

## **HOW DOES INDUSTRY CONTRIBUTE TO UNIVERSITIES?**

In the other direction, there must be something that industry contributes to universities, if this is to be a meaningful, two-way relationship. Obviously, we would expect the professional institutions to accredit our programmes and take part in some aspects of educating students. But, for the reasons stated above, if all we do is replicate today's practitioners, then we are probably failing in our duties as universities. There must be more meaningful and robust contributions from practice to research. Industry contributes by providing access to data for research, by funding research projects and taking part in informing the practical questions to which the research is addressed.

One important issue that arises from these reflections is that the academics in built environment department are typically from the construction industry, often at a professional level. Personal experience is not research, but there is a danger that the personal experience of many of our academic colleagues colours their views about what kind of insights academic research might generate. Furthermore, my feeling is that while we are concentrating on what industry and practice might do for each other, we are losing sight of the bigger question about what the built environment can do for society. We need to figure out better ways of working together. There are two things we can achieve. First, we can improve the built environment in a million different ways. Second, we can contribute to theory-building and provide insights from a complex and difficult industry sector that will help social scientists to improve their understanding of management, economics and law.

## **THE MANAGERIALIST ETHIC AND THE DECLINE OF TRUST IN SOCIETY**

Managerialism in higher education and research seems to be at the root of the problems explored in this keynote. The development of managerialism, of course, is not a problem



confined to education and research, but universities have finally caught up with a trend that has been gathering pace for several decades. The professions emerged, with an ethic of professionalism, over many years, during the emergence of industrialization. Professions offered more than mere trade, and a shared perception that emerged embraced the notion that as well as specialized knowledge and barriers to entry, there would be a code of ethical conduct and the idea of public service, not just working for the highest bidder.

The decline of professionals in construction is a symptom of a wider decline in society, the decline of trust, as described so well by O'Neill (2002), who observed that people are finding it increasingly difficult to accept professional judgement. This underlying pressure has been exacerbated in the built environment by a global shortage of skilled workers, widespread low-tech attitudes, prejudice and ubiquitous workforce problems. In place of professionalism, we seem to be witnessing the growth of something else, a malignant force of managerialism. No walk of life is safe from target-setting, performance evaluation, excessive documentation and objective yardsticks against which output can be measured. This is evident in teaching, medicine, and even the police-public work areas where concerns about the distracting impact of managerialism over the provision of a public service are being increasingly voiced. But who is listening? It is easy to shrug off these concerns because, surely, we all have to account for our actions and decisions? There are two problems with this excessive accountability: 1) it makes professionals focus on their objective knowledge rather than their judgmental skills; 2) it makes them accountable to the wrong people: regulators and bureaucrats instead of the public.

It is not easy for those in positions of power to resist the temptation to wield their power for the purposes of central control over the activities they oversee. Governments could help rebalance the focus, but the trend towards managerialism is seen as an opportunity to develop policies more likely to appeal to the widest possible range of voters. By using performance indicators and conforming to over-simplified measures of output, we can prove that we have done a good job, despite a growing dissatisfaction with our work.

A couple of decades ago, Kanter (1983: 22) was warning us about this problem:

*... the aspect of productivity that needs serious attention is not the mechanical output of a production facility; it is, rather, the capacity of the organisation to satisfy customer needs most fully with whatever resources it has at its disposal ... But mechanical notions of productivity lead often to product that meet ever more refined minimum standards, frequently resulting in a decline in customer satisfaction with them. The former thrust calls out for innovation—indeed, for innovative thinking on every level of the organisation's affairs—while the latter confines innovation to a marginal and unexciting role.*

This is still a strong statement of the problem. It seems that an organization's activities can be disaggregated, simplified and sequenced so that the room for human error is all but eliminated. But this also eliminates the need for discretion or judgment from the worker -- ironically one of the strongest human attributes, by contrast with machines. By concentrating on the connection between what customers want and what each of us can do, the organization can be much more confident about quality, and therefore about success. But this notion should concern industrial manufacturing; the possibility of it being applied, even indirectly, to a professional field like architecture is frightening. One would stumble at the first hurdle, just by having to identify who the customer is. One significant problem that is too rarely discussed in built environment research, especially in policy development, is the problem of identifying the "customer". For whom are we providing the built environment, and why? I have explored these ideas in more detail elsewhere (Hughes 2003) and it is clear to me that

the role of judgement is severely downplayed in all of our working lives, to the detriment of everything that we do.

## CONCLUSIONS

In conclusion, it is clear that the built environment has an interesting and important role to play in confronting many of the major problems facing society, all over the world. We need to help people to understand that the built environment is not only an employer, not only a producer of built facilities, but also an enabler of processes that are housed in built facilities and a potential source of new ideas and stronger theories about how people interact and behave. Our impact in studying and researching in the built environment should be oriented towards the problems confronting society, not just the problems of making buildings more efficiently. This is a message that should be hammered home in built environment education at all levels. Not only that, but also our education programmes should be based on research into the phenomena that we observe. Our theory-building and theory-testing needs to be connected to more fundamental academic disciplines, not developed in isolation. This way, we have a chance to influence more than just built environment education and practice. But to make these contributions, we have, at the same time, to acknowledge that there are areas of expertise that are more strongly developed than ours, and that if we seek to influence others, we have to stop “re-inventing the wheel” and learn about how to conduct and report robust research. My hope and belief is that conferences like WABER can help us to understand how we can contribute to some of the important questions that confront humanity.

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# BUILT ENVIRONMENT RESEARCH AND THE MILLENNIUM DEVELOPMENT GOALS

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The target date for attaining the Millennium Development Goals (MDGs) is 2015. The reports indicate that progress towards attaining many of the goals has been slow although there are some encouraging results. What are these goals? What has been the progress towards the achievement of the goals? What are the main areas which need to be addressed? How relevant are the MDGs to the built environment in general and construction in particular? What can researchers who work in the area of the built environment in general and construction in particular do to help in the efforts towards the attainment of these goals? What has been done so far in these regards? What is the way forward? The built environment in any country determines the nature and pace of national development, and the quality of life of the people. It has a major influence on progress towards the attainment of the MDGs. The construction industry, which produces this environment, must be able to play its due role if it is not to be a barrier to progress in these regards. Research on how to improve the performance of the industry would be of benefit.

Keywords: millennium declaration, targets, Africa, construction industry, research agenda.

## INTRODUCTION

In a 2009 report, the Secretary-General of the United Nations noted (UN, 2010, p. ii):

The global community cannot turn its back on the poor and the vulnerable. We must strengthen global cooperation and solidarity, and redouble our efforts to reach the MDGs and advance the broader development agenda. Nothing less than the viability of our planet and the future of humanity are at stake. I urge policymakers and all stakeholders to heed the message of this valuable and timely report.

The report was on progress towards the attainment of the Millennium Development Goals (MDG). Are the MDGs of relevance to the built environment in general and to the construction industry in particular? Do calls like this one relate also to researchers? What is the responsibility of researchers in Construction Management and Economics in the efforts to attain the MDG? What are the MDGs, anyway? What has been the progress towards their attainment, especially in Africa? What can the construction industry do?

## MILLENNIUM DEVELOPMENT GOALS

### The Millennium Declaration

The Millennium Declaration was signed in New York in September 2000 by some 150 heads of state of member countries of the United Nations (UN). The leaders reaffirmed the

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commitments of their countries to the UN charter, and outlined “certain fundamental values ... essential to international relations in the twenty-first century” (UN, 2000) including: freedom, equality, solidarity, tolerance, respect for nature, and shared responsibility. The objectives in the declaration were: (i) Peace, Security and Disarmament; (ii) Development and Poverty Eradication; (iii) Protecting Our Common Environment; (iv) Human Rights, Democracy and Good Governance; (v) Protecting the Vulnerable; (vi) Meeting the Special Needs of Africa; and (vii) Strengthening the United Nations. Under objective (ii) of the declaration, it was stated (UN 2000, section iii, paras 19 and 20):

“19. We resolve further:

- To halve, by the year 2015, the proportion of the world’s people whose income is less than one dollar a day and the proportion of people who suffer from hunger and, by the same date, to halve the proportion of people who are unable to reach or to afford safe drinking water.
- To ensure that, by the same date, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling and that girls and boys will have equal access to all levels of education.
- By the same date, to have reduced maternal mortality by three quarters, and under-five child mortality by two-thirds, of their current levels.
- To have, by then, halted, and begun to reverse the spread of HIV/AIDS, the scourge of the malaria and other major diseases that afflict humanity.
- To provide special assistance to children orphaned by HIV/AIDS.
- By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers as proposed in the ‘Cities Without Slums’ initiative.”

“20. We also resolve:

- To promote gender equality and the empowerment of women as effective ways to combat poverty, hunger and disease and to stimulate development that is truly sustainable.
- To develop and implement strategies that give young people everywhere a real chance to find decent and productive work.
- To encourage the pharmaceutical industry to make essential drugs more widely available and affordable by all who need them in developing countries.
- To develop strong partnerships with the private sector and with civil society organizations in pursuit of development and poverty eradication.
- To ensure that the benefits of new technologies, especially information and communication technologies ... are available to all.”

These clauses were summarised into eight MDGs which were, in turn, translated into 18 specific targets to be achieved by 2015 (see Table 1). There were also 48 indicators for monitoring progress in achieving the goals (<http://www.developmentgoals.org>).

It is pertinent to note that this was not the first time that “global development targets” had been set out; there had been a series of them in the 1990s (Fay et al., 2005). However, the MDGs have brought into being the most comprehensive set of co-ordinated actions to attain their targets. The governments of virtually all countries, and international and national organizations have committed themselves to a global partnership to achieve the MDGs. They have formulated policies and programmes, with specific targets, monitoring frameworks and assessment tools (for example, the Global Monitoring Report (GMR) which is published annually by the International Monetary Fund (IMF) and the World Bank assesses progress in the implementation of the policies and initiatives needed to attain the MDGs). The sixth

objective of the Millenium Declaration is “Meeting the Special Needs of Africa”. Many initiatives have been taken to deliver on this promise. An example is the World Bank’s Africa Action Plan of 2005 (<http://www.worldbank.org/afr/aap>) which sought to achieve development results in good governance, closing the infrastructure gap, building capable states, and more equitable distribution of the benefits of development.

Table 1 The Millenium Development Goals and Targets

MDG	Targets
Goal 1: Eradicate extreme poverty and hunger	<ul style="list-style-type: none"> <li>* Reduce by half the proportion of people living on less than a dollar a day</li> <li>* Reduce by half the proportion of people who suffer from hunger.</li> </ul>
Goal 2: Achieve universal primary education	<ul style="list-style-type: none"> <li>* Ensure that all boys and girls complete a full course of primary education.</li> </ul>
Goal 3: Promote gender equality and empower women	<ul style="list-style-type: none"> <li>* Eliminate gender disparity in primary and secondary education preferably by 2005 and in at all levels by 2015.</li> </ul>
Goal 4: Reduce child mortality	<ul style="list-style-type: none"> <li>* Reduce by two-thirds, the mortality rate among children under five</li> </ul>
Goal 5: Improve maternal health	<ul style="list-style-type: none"> <li>* Reduce by three-quarters, the maternal mortality ratio</li> </ul>
Goal 6: Combat HIV/AIDS, malaria and other diseases	<ul style="list-style-type: none"> <li>* Halt and begin to reverse the spread of HIV/AIDS</li> <li>* Halt and begin to reverse the incidence of malaria and other major diseases.</li> </ul>
Goal 7: Ensure environmental sustainability	<ul style="list-style-type: none"> <li>* Integrate the principles of sustainable development into country policies and programmes; reverse the loss of environmental resources</li> <li>* Reduce by half the proportion of people without sustainable access to safe drinking water</li> <li>* Achieve significant improvement in the lives of at least 100 million slum dwellers by 2020.</li> </ul>
Goal 8: Develop a global partnership for development	<ul style="list-style-type: none"> <li>* Develop further an open trading and financial system that is rule-based, predictable and non-discriminatory, includes a commitment to good governance, development, and poverty reduction—both nationally and internationally</li> <li>* Address the least developed countries’ special needs. This includes tariff- and quota-free access for exports; enhanced debt relief for highly indebted poor countries; cancellation of official bilateral debt; and more generous official development assistance for countries committed to poverty reduction</li> <li>* Address the special needs of landlocked and small island developing States</li> <li>* Deal comprehensively with developing countries’ debt problems through national and international measures to make debt sustainable in the long term</li> <li>* In co-operation with the developing countries, develop decent and productive work for the youth</li> <li>* In co-operation with pharmaceutical companies, provide access to affordable, essential drugs in the developing countries</li> <li>* In co-operation with the private sector, make available the benefits of new technologies—especially information and communications technologies.</li> </ul>

The role that the private sector is playing is most evident when one considers initiatives by their groupings. For example, with respect to the MDGs, the World Business Council for Sustainable Development (WBCSD) (2005) seeks to: (i) learn by sharing – deliver tools and guides that advance understanding of development challenges and enable all sectors to

address them; (ii) advocate the business contribution – help business to work with all stakeholders to build synergies among programmes; and (iii) learning by doing – demonstrate success through pilot investments and exploit synergies across sectors. The WBCSD’s “workstreams” in this area focus on sustainable production and consumption, by its members, evaluation of the socio-economic impact of businesses and a focus on the development of small and medium-sized enterprises (SME).

### **Funding the MDG programmes**

It was estimated that, to attain the MDGs, developing countries must grow by 7-8 percent per annum (World Bank 2004), and that US\$50 billion per annum in additional external funds would be required. Official aid flows were projected to rise from US\$69 billion in 2003 to US\$135 billion in 2006, and then to US\$195 billion by 2015 (Millennium Project 2005). There have been commitments to provide more resources to Africa (in line with the sixth objective of the declaration). At the G8 leaders’ summit in 2005, the world’s eight richest countries pledged to double development aid to Africa from US\$25 billion in 2004 to US\$50 billion per year by 2010; and to deepen debt relief especially for countries with sound financial management and a commitment to poverty reduction. The IMF (2010) notes that a major step toward meeting the MDGs was taken in Mexico in March 2002 when the international community adopted a two-pillar strategy, whereby sustained pursuit of sound policies and good governance by the low-income countries is to be matched by larger and more effective international support and an enabling international economic and trade environment for development.

Progress in most of the pledges has been slow. The arguments on many aspects of aid, including the most appropriate nature, continue. Baulch (2006) found that most donors are not distributing their aid in a way that is consistent with the MDGs, i.e., they do not direct large shares of their concessionary aid flows to the poorest and most deprived countries. Dalgaard and Erickson (2009) address these questions: (i) how much growth should aid flows have produced in Sub-Saharan Africa over the last three decades? and (ii) how much aid would be needed to attain the first MDG (MDG1) of cutting poverty in half by 2015? Their analysis indicates that expectations for aid in fostering growth and poverty reduction have been too high; and that aid may not be as effective in reducing poverty as other analyses have suggested. However, it would be a mistake to interpret their results as showing that aid is ineffective. Rather, the results indicate that the potential overall effect of aid on growth is likely to be modest.

Powell and Bird (2010) ask: “Have debt relief initiatives complemented or substituted for other aid? Has debt relief been additional?” They examine the relationship between debt relief and other foreign aid in 42 sub-Saharan African countries using panel data for 1988-2006. They find that the relationships between debt, debt relief, aid, and resource transfers have changed over time. They note that the international community is paying attention to helping low-income countries achieve the MDGs. The results confirm the significance of population, the conduct of economic policy, and the need of a recipient. Debt relief schemes since 1988 all seem to have had a significant positive effect on net transfers to participating countries. Most debt relief has therefore, on average, been additional for recipients. They also discover that for much of the period up to 2000, aggregate net aid transfers to sub-Saharan African Africa actually fell in both real and nominal terms.

From the above discussion, it is evident that progress towards meeting the MDGs will not come only from additional foreign aid; supplementary solutions are required. For example, the IEG (2006) found that only 2 in 5 of the countries borrowing from the World Bank recorded continuous per capita income growth in 2000-05 and only 1 in 5 over 1995-2005.

## MDGS IN THE LITERATURE

There is much discussion in the literature on many aspects of the MDGs including such fundamental issues as their appropriateness. Not all researchers welcome the MDGs. First, some believe that the goals might lead to wrong prioritization. Maxwell (2003) points out that the MDGs might encourage oversimplified interventions emphasising social indicators at the expense of economic growth. The Independent Evaluation Group (IEG) of the World Bank (2006) notes that achieving high quality development results takes time, but pressure to show results can divert attention from the quality of results. For example, efforts to attain the MDG of ensuring universal completion of primary education have led to efforts to increase enrolments, often at the expense of attention to learning outcomes. In Uganda, there were 94 children per classroom, and 3 children share a textbook, whereas in Ghana, the development programme in the education sector combined policy reforms with the provision of school buildings and teaching materials.

Second, some authors believe the MDGs are unrealistic. Clemens et al. (2007) find fault with the way the MDGs (most of which they consider as overreaching) were set, and assert that they are impossible to meet. Clemens et al. (2007: 747) observe that indicating that the MDGs can be met merely with increased resources “contributes to the illusion that the goals are attainable for all countries”. They suggest that the specific MDG targets “have set up many countries for unavoidable ‘failure’” (p. 747), even as they pursue good policies and make progress on some development indicators.

The third point is the question, “Whose goals are they, anyway?” White and Black (2004) note that the MDGs would not be effective as accountability for failing to meet them is diffuse. Some authors consider the MDGs to be unsuitable for Africa’s circumstances and needs. Easterly (2009) notes that many routinely state that “Africa will miss all the MDGs”. He argues that some arbitrary and arcane choices made in defining “success” or “failure” as achieving numerical targets for the MDGs made attainment of the MDGs less likely in Africa than in other regions even when its progress was in line with or above historical or contemporary experience of other regions. This has the effect of making African successes look like failures. He finds flaws in each of the seven MDGs from Africa’s perspective:

1. it was less likely that Africa compared to other regions would achieve a 50 percent reduction in poverty over 25 years as it had the lowest *per capita* income, which is associated with the smallest percentage reduction in poverty for the same growth rate
2. it was less likely that Africa would attain the level target of universal primary enrolment because it started with the lowest initial primary enrolment and completion.
3. the primary enrolment component of gender equality in schooling is numerically equivalent to universal enrolment, so other regions that were closer to attaining MDG2 could count the attainment of MDG2 twice
4. a two-thirds reduction in child mortality is less likely when a region starts at very high mortality, as Africa did
5. Africa was said to be failing the goal of reducing maternal mortality by two-thirds, but there were no reliable data on maternal mortality trends
6. Africa was said to be failing to reduce AIDS, malaria, and tuberculosis prevalence, but there were no reliable data on trends in these prevalence rates
7. Africa was relatively falling behind on reducing the percent without access to clean water, but it would have been relatively catching up if it had been measured the conventional way of percent with access to clean water.

Easterly (2009) also notes that the implied picture that Africa is failing to meet all seven MDGs is not fair because the continent has made much progress in many of the social

indicators. The negative picture is demoralizing to African leaders and activists, and might have consequences for things like foreign investment. Indeed, the vice-chair of the UN inter-agency committee which designed the MDGs has recently protested that they were meant to apply only at the only global level, not at the country or regional level (Vandemoortele, 2007 Vandemoortele, J. (2007). The MDGs: 'M' for misunderstood? *WIDER Angle* (pp. 6–7). United Nations World Institute for Development Economics Research. Vandemoortele, 2007), and he also criticizes the demoralizing effect of labeling Africa an MDG “failure.” Tabatabai (2007) suggests that if this is the intention, then the MDGs are “not so much misunderstood as misconceived”.

Finally, proposals are made for better goals and targets. Clemens et al. (2007) suggest that future development goals should: (i) be country-specific and flexible; (ii) take historical performance into account; (iii) focus more on intermediate targets than outcomes; and (iv) be considered benchmarks rather than goals which are technically feasible with sufficient funds alone. Tabatabai (2007) proposes that “The real yardstick for judging performance and effort is whether they have done the best they could under the circumstances.”

Some authors argue about the need for particular goals, and the relationships among them. Fay et al. (2005) note that some observers believe that since improvements in most indicators of development are highly co-related with increases in per capita income, MDGs 2 to 8 are superfluous as long as the first goal is tackled. Studies have found relationships among many of the MDGs, appearing to indicate the relevance of each of them. For example, Abu-Ghaida and Klasen (2004) note that many empirical studies have found that gender equity in education promotes economic growth, and reduced fertility, child mortality, and undernutrition. Wisniewski (2010) estimates the impact of nutrition and health problems on test scores of grade four students in Sri Lanka using data on child height, weight, hearing and vision problems, helminthes infections, malaria, and micronutrient deficiencies. The results show that stunting and hearing problems in children have *direct* impact on tests scores. The production function results for academic skills show that better early childhood nutritional status has a positive, significant direct impact on test scores. They also show that infrequent or sporadic infections and/or health problems may cause less of a disruption to the learning process and have less of an effect on test scores than persistent health problems such as early childhood nutritional status and hearing problems.

## **CURRENT RESULTS AND NEED FOR FURTHER ACTION**

### **Current results**

The World Bank (2006a) indicates that joint efforts to reach the MDGs are falling short. Whereas the world was on target to reduce extreme poverty by half by 2015, performance varies among regions. Greatest progress had been in Asia, especially in China and India. In China, between 1990 and 2005, the number of people living on less than US\$2 a day fell by over 400 million. In India, the level of poverty fell from 36 percent in 1993-94 to 26 percent in 1999-2000. Sub-Saharan Africa was unlikely to meet the goal (World Bank, 2006b). The 2009 GMR again concludes that although the global economic crisis slowed progress, the goal of halving extreme poverty between 1990 and 2015 remains within reach at the global level based on current growth projections. The number of people living in extreme poverty in developing countries fell from 1.8 billion in 1990 to 1.4 billion in 2005 (i.e., from 42 percent to 25 percent of the population), with the decline being largest in East Asia.

Progress has been made in some countries in Africa. The World Bank (2007b) reports that 13 sub-Saharan African countries have attained middle-income status, with another five on course. Africa is the world's third fastest region in the pace of reforms to reduce the time and



cost needed to start a business (World Bank and IFC, 2006). However, the World Bank (2007b) reports that more than 314 million Africans—nearly twice as many as in 1981—live on less than \$1 a day. Thirty-four of the world's 48 poorest countries, and 24 of the 32 countries ranked lowest on the UN's Human Development Index, are in Africa. Most African countries remain high-cost, high-risk places to do business (World Bank and IFC, 2006). Africa receives only about 10 percent of foreign direct investment to developing countries. Indeed, the early studies on progress towards achieving the MDGs were not encouraging. Sahn and Stifel (2002) assessed progress on six MDGs relating to living standards in Africa and painted a discouraging picture.

The Latin America and Caribbean region grew by 6.0, 4.5 and 5.0 percent in 2004, 2005 and 2006 respectively because of higher export revenues and volumes resulting from high commodity prices and world growth (World Bank, 2007c). The countries have achieved significant progress in education. In Mexico, a project helped increase completion rates in primary education from 66 percent in 1994-95 to 80 percent in 2000-2001 in disadvantaged communities in 14 of Mexico's poorest states. However, the region continues to face the related development challenges of increasing growth, while reducing poverty and inequality – some 106 million people (nearly 21 percent of the population) live on less than \$2 a day.

The 2009 GMR concluded that, on current trends most human development MDGs are unlikely to be met at the global level. Although deaths of children under five declined worldwide, to about 9 million in 2007, from 12.6 million in 1990, despite population growth. Sub-Saharan Africa and, in some cases, South Asia are likely to fall short of most, especially in the areas of child and maternal mortality, access to basic sanitation, and reducing child malnutrition. The HIV prevalence rate has shown some decline in Africa but has risen in some other regions. There is more hope in education. Whereas the goal of universal primary school completion would be missed on a global basis, the attainment will be close. Again, the largest shortfalls are likely to be in Sub-Saharan Africa and South Asia. The goal of eliminating gender disparity in primary and secondary education seems attainable by 2015, although Sub-Saharan Africa is likely to fall short.

Major accomplishments were made in education. Enrolment in primary education in developing countries as a whole reached 88 percent in 2007, up from 83 per cent in 2000. In sub-Saharan Africa and Southern Asia, enrolment increased by 15 percentage points and 11 percentage points respectively, from 2000 to 2007.

Several authors have recently asked: "What is to be done?" with respect to Africa. Fagerberg et al. (2007) ask: "Why do some countries perform much better than other countries?" They identify four aspects of competitiveness: technology, capacity, demand, and price. The empirical analysis, based on a sample of 90 countries on different levels of development during 1980-2002, demonstrated the relevance of technology, capacity, and demand competitiveness for growth and development. Price competitiveness seems generally to be of lesser importance. Deteriorating technology and capacity competitiveness are, together with an unfavorable export structure, the main factors hampering many developing countries in exploiting the potential to catch-up in technology and income. When unfavorable geography, nature, and climate add to the effects of failing competitiveness serious problems may arise, as exemplified by the countries of sub-Saharan Africa.

Another common question is: "What can Africa learn from the more successful East Asian countries such as China?" Ravallion (2009) notes that at the beginning of China's reform period, it had a higher poverty rate than Africa as a whole. Within five years that was no longer true. He explains how China escaped from extreme poverty. While acknowledging that Africa faces constraints that China did not, there were two lessons for Africa. The first is

the initial importance of productivity growth in smallholder agriculture, which requires market-based incentives and public support. The second is the role of strong leadership and a capable public administration at all levels of government. Policy messages worth thinking about in Africa include access to sound basic education and health care, lower dependency rates through lower fertility, greater internal market integration, and greater openness to foreign investment and trade, consistent with a country's comparative advantage. There are signs of progress in Africa in most of these areas but there is still much to be done.

### **Need for further action**

More work needs to be done to attain the MDGs. UN (2010) considers the most pressing as:

1. efforts to provide productive and decent employment for all, including women and young people, must be intensified
2. the war on hunger must be waged with more vigour
3. greater efforts must be made to get *all* children into school, especially those in rural areas, and eliminate inequalities in education based on gender and ethnicity, and among linguistic and religious minorities
4. more should be done to reduce maternal mortality, especially in sub-Saharan Africa and Southern Asia, where not much progress has been made so far
5. much more should be done to bring improved sanitation to the 1.4 billion people who did not have access to it in 2006 (at the present rate of progress, the 2015 sanitation target will be missed)
6. greater efforts must be made to improve the living conditions of the urban poor (slum improvements are not keeping pace with the rapid growth of developing country cities)
7. greater priority must be given to preserving the natural resource base and to combat climate change.

## **BUILT ENVIRONMENT, CONSTRUCTION AND MDGS**

### **Nature and Potential of Construction**

The construction industry, which creates the built environment, is arguably the main vehicle through which the MDGs can be realised. The features of the industry may be used as a framework to discuss the potential of construction in these regards (see, for example, Hillebrandt, 2000; Ofori, 2000). First, buildings and items of infrastructure are vital inputs for economic activity (both production of goods and provision of services), leading to economic growth and increased incomes in the short run, and national development in the long run. For example, the provision of school buildings (MDG2) and health facilities (MDG4 and MDG5) as well as the houses that meet the slum improvement objective in the Millenium Declaration are all directly from construction.

Second, construction activity has extensive linkage effects, and stimulates activities in other sectors of the economy from which the industry obtains its inputs, such as manufacturing, commerce and financial (banks, insurance companies) and business (lawyers, accountants) services. This contributes further to economic growth and development, implying that investment in construction has significant multiplier effects. Third, construction provides employment opportunities in the form of direct employment in the industry and part-time work. The firms adopt flexible recruitment practices to attain greater flexibility. Thus, construction workers are effective consumers in the economy, further stimulating activities in other sectors and raising incomes generally. Fourth, construction is location specific. Thus, the employment generation potential and stimulation of the local economy can be realized in all parts of the country.

Table 2 The Millenium Development Goals and role of construction

Millenium Development Goal	Contribution of Construction and Research Implications	Indicators for Construction
Goal 1: Eradicate extreme poverty and hunger	<ul style="list-style-type: none"> <li>* Effective and efficient production of buildings and infrastructure</li> <li>* Maximum linkages of construction to other sectors of national economy to create stimulus</li> <li>* Generation of employment opportunities through appropriate choice of technology and procurement</li> <li>* Continuous development of industry.</li> </ul>	<ul style="list-style-type: none"> <li>* Performance of industry, company or project on key indicators, such as time, cost, quality, safety</li> <li>* Features of construction in national input-output tables</li> <li>* Number of jobs created, average wages</li> </ul>
Goal 2: Achieve universal primary education	<ul style="list-style-type: none"> <li>* Design and construction of suitable school buildings (in local economic, climatic contexts)</li> <li>* Contribution to economic growth and national development to create jobs for graduates</li> </ul>	<ul style="list-style-type: none"> <li>* Average corporate profits; profits on projects</li> <li>* Estimate of total capacity of national industry, and that of the firm.</li> </ul>
Goal 3: Promote gender equality and empower women	<ul style="list-style-type: none"> <li>* Creation of job opportunities for women and youth (MDG8) at all levels in construction, with close attention to working conditions on sites, pay and career progression</li> </ul>	<ul style="list-style-type: none"> <li>* Proportion of females in workforce of industry, company, project, at different levels</li> <li>* Average remuneration of employees of different genders.</li> </ul>
Goal 4: Reduce child mortality	<ul style="list-style-type: none"> <li>* Construction of hospitals and infrastructure</li> <li>* Provision of job opportunities to generate income.</li> </ul>	<ul style="list-style-type: none"> <li>* Same indicators as for MDGs 1 and 2.</li> </ul>
Goal 5: Improve maternal health		
Goal 6: Combat HIV/AIDS, malaria and other diseases	<ul style="list-style-type: none"> <li>* Effective site management to avoid health hazards</li> <li>* Initiatives to avoid spread of HIV/AIDS by construction workers (through education).</li> </ul>	<ul style="list-style-type: none"> <li>* Industry, company, project performance on health and safety</li> <li>* Industry and company policies and programmes on HIV/AIDS.</li> </ul>
Goal 7: Ensure environmental sustainability	<ul style="list-style-type: none"> <li>* Sustainable construction – cradle to grave considerations of all aspects of construction</li> <li>* Effective management of completed buildings and infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>* Industry, company, project performance on sustainable construction – waste generation;</li> <li>* Average scores in environmental assessment of buildings</li> <li>* Energy performance of various types of buildings..</li> </ul>
Goal 8: Develop a global partnership for development	<ul style="list-style-type: none"> <li>* Construction as a partner for development – study construction's role in development in order to enhance it</li> <li>* Construction as a creator of wealth and less of a burden in imported inputs</li> <li>* Research on, and develop, construction industries in developing countries to enable them to play a role in globalising economies</li> <li>* Effective logistics of construction in landlocked and small island developing states</li> <li>* Effective construction technology transfer in construction – from research to practice; from industrialised to developing countries</li> <li>* Partnership among industry, government, researchers</li> <li>* Global networks of researchers to study matters on construction and MDGs.</li> </ul>	<ul style="list-style-type: none"> <li>* Same indicators as for MDGs 1 and 2.</li> </ul>

Source of MDGs: United Nations [http://www.un.org/millenniumgoals/images/mdgs\\_01.gif](http://www.un.org/millenniumgoals/images/mdgs_01.gif)

From the above discussion, the construction industry and its processes can be a bottleneck in the effort to realise the MDGs. Therefore, the capacity and capability of the industries in Africa should be enhanced to enable them to deliver a higher volume of output to meet the increased demand from initiatives to realise the MDGs, and to do so in a cost effective and time efficient manner, and to a high quality and with overall value for money.

### **Built environment and MDGs in the literature**

There have been studies, and some debate, on the effects of initiatives to attain the MDGs, and many of these relate to the items created by the construction industry in the built environment. Fay et al. (2005) found that better access to infrastructure (piped water, sanitation and electricity) has a large and statistically significant effect in reducing infant and child mortality and incidence of malnutrition. Ravallion (2007) disputes these findings, questioning the estimating methods adopted. He also concluded that (contrary to the findings of Fay et al.) there was complementarity between basic infrastructure and health care, whereby at sufficiently high levels of initial health care, improvements in basic infrastructure reduce infant and child mortality and the incidence of malnutrition. In response, Fay et al. (2007: 930) highlight the complexity of the situation and call for more research. Li (2009) added to, and confirmed, the studies around the world which have shown that there is a significant correlation between children's development and the neighbourhood built environment in which they are brought up.

The literature has long highlighted the employment generation potential of construction (Hillebrandt 2006). This potential can be most effectively realised through the adoption of appropriate procurement approaches and technologies. Greater attention should be paid to technology assessment and selection (see, for example, ILO 2003). There is a potential negative aspect of this potential. Studies have found that construction sites and their workers contribute to the spread of mosquito-borne diseases (Vijayan and Neo 2007) and HIV/AIDS (Meintjes et al. 2007). Thus, working conditions on sites should be improved to reduce the spread of diseases among the industry's workers and the community.

The literature highlights the role of infrastructure in economic growth and development (Han and Ofori, 2001 provide a useful review). Fedderke et al. (2006) analysed data for South Africa from 1875 to 2001 and found that investment in infrastructure leads to long-term economic growth both directly and indirectly, the latter by increasing the marginal productivity of capital. Fedderke and Bogetić (2009) note that empirical explorations of the growth and aggregate productivity impacts of infrastructure have been characterized by ambiguous results with little robustness. They use 1970-2000 panel data for South African manufacturing and a range of 19 infrastructure measures and explore the question of infrastructure endogeneity in output equations. They conclude that controlling for the possibility of endogeneity in the infrastructure measures renders the impact of infrastructure capital not only positive, but of economically meaningful magnitudes.

The World Bank (2007a) notes that improving infrastructure in developing countries is a key factor in reducing poverty and increasing growth; it is vital to the achievement of the MDGs as it improves access to water and electricity, as well as schools, hospitals, and markets. The World Bank (2007a) observes that if Africa had attained infrastructure growth rates comparable to those in East Asia in the 1980s to 1990s, it could have achieved annual growth rates about 1.3 percent higher. Similarly, it is estimated that the lack of investment in infrastructure in the 1990s reduced long-term growth in the Latin America and Caribbean region by 1-3 percentage points, and hindered the region's ability to compete with the dynamic Asian economies (World Bank 2007d). Eifert et al. (2008) observe that data from the World Bank Enterprise Surveys show that indirect costs (related to infrastructure and

services) account for a relatively high share of firms' costs in poor African countries and pose a competitive burden on African firms. The high indirect cost shares observed in firms in poor African countries reflect underlying fundamentals which increase the costs of African firms relative to their competitors. These differences are significant; the difference between the indirect cost levels faced by comparable Zambian and Chinese firms is almost equivalent to the whole wage bill of the former. Kinda (2010) uses firm-level data across 77 developing countries to show that constraints related to investment climate hamper foreign investment. The results show that physical infrastructure problems, financing constraints, and institutional problems discourage foreign investment. As investment climate constraints, he focused on physical and financial infrastructure problems in addition to human capital and institutional constraints. The main results show that improving physical and financial infrastructures increases the probability of receiving a foreign firm.

There are many recent examples of the economic and social stimulus from investments in infrastructure. Two World Bank (2007d) projects in Peru rehabilitated 13,000 kilometers of rural roads, reducing travel time by an average of 68 percent; and increasing school enrolment by 8 percent and visits to health centres by 55 percent. In Morocco, the construction of an all-weather road in rural communities increased girls' primary school attendance from 28 percent to 68 percent. Gunasekera et al. (2008) note that when transport investments are made in relatively infrastructure regions, the consequences extend beyond growth effects to some transformational changes. They estimate the direction and magnitude of some of the transformational changes induced at the firm and household level using a highway project in Sri Lanka. They conclude that in a region with limited public capital stock, a highway improvement may potentially induce a dual structural shift: the emergence of a new social and technical environment (or a new set of economic opportunities), and a change in the pattern of relationships between the environment and social actors. The original feasibility study of the highway project forecast traffic growth of 4-6%, driven by the agriculture sector. In reality, traffic grew by 10%, and economic growth occurred by more factors than predicted.

## **ADDRESSING MDGS IN BUILT ENVIRONMENT AND CONSTRUCTION**

Action has been taken to use construction activities and products in the built environment directly to realise the MDGs, especially MDG1. Engineers Against Poverty (2006) identifies opportunities to improve the delivery of social development objectives by modifying the way in which public infrastructure projects are procured. It suggested that: (i) project identification should be in line with national, local or sector plans and/or based on public consultation; (ii) the whole life cycle of the project should be considered during planning and design, and a maintenance strategy developed; (iii) social objectives should be identified at the planning stage and fed into design; (iv) funds should be set aside in the budget for the realisation of social objectives; (v) an appropriate procurement approach to deliver the specified social objectives should be chosen; (vi) the bidders' social performance and capacity to deliver social obligations should be considered; (vii) contractual obligations must be monitored and enforced through incentives and/or sanctions; and (viii) social performance audits should be conducted with the same rigour as financial audits.

The ILO (2006: 3) suggests that municipalities should launch investment policies and programmes with the following elements: (i) employment-intensive infrastructure development for upgrading unplanned settlements and rehabilitating facilities for people affected by disasters and conflicts; (ii) provision of social infrastructure for accessibility, water, health, education, markets, rehabilitation and preservation of national heritage; (iii)

organisation and association building, negotiation and contracting capacity building for communities and informal economy operators, and support to SMEs; (iv) provision of support to local governments, community groups and the private sector in pro-poor procurement and community contracting; (vi) review of the local regulatory environment to improve their impact on job creation and the quality of jobs created; and (vii) integrated employment and environmental impact assessments of urban investment plans.

The WBCSD (2005) showcases several programmes and projects in which some of its member companies are taking action, moving beyond philanthropy and corporate social responsibility to business relationships. For example, under the “House-for-Life” programme in Sri Lanka, launched in 2005, Holcim, the leading cement provider in the country, has formed a partnership with Ceylinco Grameen (a microfinance institution) to address the housing needs of the poorest citizens. Micro-entrepreneurs borrow money to buy a home designed as a shophouse, which provides each family the premises to run a business. Holcim provides the initial funds and technical skills, and Ceylinco administers the loan.

Gibson and Olivia (2010) note that whereas access to infrastructure is identified in some studies as a factor that affects non-farm rural employment and income, less attention has been paid to the constraints imposed by poor quality infrastructure. They analyse data from 4,000 households in rural Indonesia to show that the quality of roads and electricity affects both employment in, and income from, non-farm enterprises. The results support the view that poor infrastructure constrains rural non-farm enterprises. Moreover, there is a negative effect of poor quality infrastructure. Thus, there would be gains from development strategies that improve both the access to and the quality of rural infrastructure.

Davidson et al. (2007) note that it has been widely accepted by policy makers, actors and researchers that the key to performance in low-cost housing projects in developing countries lies in community participation. There is a continuum of possibilities of participation by users or beneficiaries in post-disaster reconstruction projects: at one extreme, users are involved in the projects only as the labour force, whereas at the other, they play an active role in decision-making and project management. Four case studies of post-disaster housing reconstruction projects (one each in Colombia and in El Salvador, and two in Turkey) illustrate this continuum. Their study shows that the participation of users in up-front decision-making (within the project design and planning phases) leads to positive results in terms of building process and outcomes. Lyons (2009) notes that post-disaster reconstruction often fails in its stated objectives and these failures may be traced to the centralizing approaches generally taken to reconstruction. He analyses two main housing reconstruction policies adopted in post-tsunami Sri Lanka. He found that the owner-driven programme performed better than the donor-assisted programme by producing more houses, more quickly, of better construction quality, and at less cost. Space standards were generally better, and the designs, layouts and locations were more acceptable to beneficiaries. Infrastructure, services, and amenities were more readily provided to the sites. The donor-aided programme fostered a culture of dependency among beneficiaries who played no active role in the development of their own futures, and did not meet its own objectives.

### **Recent built environment research and MDGs in Africa**

Two recent research studies demonstrate many of the objectives of this paper: relationship between the built environment and the MDGs; use of construction projects and process to attain MDGs; and the role of built environment researchers in studying the MDGs and helping to attain them. In the first project, Majale (2008) presents an action research project that aimed to improve the living conditions and lives of the urban poor in three slums in Kitale, Kenya. The project set out to test whether a participatory planning approach and the

creation of partnerships between slum communities and the public, private and NGO sectors could build local capacity to assess and address the needs of slum dwellers through slum upgrading. He recommended that there should be co-ordinated policies and action on employment creation through participatory urban planning, partnership building and working, and slum upgrading.

It is worth discussing the second project in some detail. Jason (2008) presents a study of informal construction workers in Dar es Salaam, Tanzania, to show how social dialogue was used in finding solutions to the problems encountered in the informal sector which is important for urban development. At workshops organized by the project, the workers expressed the view that most construction projects are available in the government sector but they cannot access them because they lack official recognition. They requested: (i) assistance to form an umbrella organization to fight for official recognition; (ii) government to set aside a proportion of its development funds to procure products and services supplied by informal construction workers; and (iii) the policy of using labour-based technology should be extended to the maintenance of urban infrastructure to create opportunities for employment in urban areas. The 38 groups subsequently formed an umbrella organization. The government changed some policies to accommodate the needs of the informal construction workers. For example, the Contractors Registration Board developed a new category for informal construction workers with eligibility to bid for works worth up to Tsh. 75 million (about US \$75,000). The national vocational training institute, through the social dialogue process, developed a course for informal construction workers. Also, through such dialogue, one foreign company in Tanzania requested the umbrella body for a database of its member groups to it, so that it can select workers from it.

## **RESEARCH AGENDA**

In Table 2, the research implications of the aspects of construction and the built environment which relate to the MDGs are outlined. More subjects for research are considered in this section. It is necessary for construction researchers to undertake work on the MDGs themselves from the perspective of construction, in order to contribute to the development of suitable objectives and targets. For example, Sanusi (2008) attempts to contribute to the discussion on the human development index (HDI) which is a popular measure of human well-being, used by academics, policy makers, governments and development agencies, and applied in ranking countries annually. The index has been criticized on many grounds so efforts are being made to widen the scope of issues it covers. The study examines housing facilities, housing adequacy, housing space and solid waste disposal as part of issues that affect human development. While the possession of these amenities by households contributes to human development, their absence will constitute some form of deprivation.

As an over-arching aim, each research study on the built environment should seek to consider, among its objectives, the extent to which the findings would have an impact on the realisation of relevant MDG targets. Ofori (2007) made this plea at a conference in the UK but it was not warmly received. Some of the points raised by the participants felt that the MDGs were illegitimate and patronizing impositions by outsiders; researchers should be allowed to have their freedom to explore; and funding agencies have their own requirements which do not relate to the MDGs. Built environment researchers in developing countries do not have the luxury to be able to detach themselves from their nations' needs.

There should be research on the direct relationships between construction activity and some of the MDGs. Some relevant topics include: (i) the relationship between construction activity and economic growth and development; (ii) the influence of various individual types of construction projects, such as a road, a bridge or a school, on economic growth; (iii) the

forward and backward linkages between construction and other sectors of the economy; (iv) the amount of employment generated by a unit of different categories of construction work; (v) the relationship between improved construction industry performance and attainment of relevant MDG targets; (vi) the importance of the informal sector in the construction industry; (vii) employment generation in construction in both urban and rural areas; (viii) stakeholder consultation and involvement to enhance benefits from construction projects; (ix) the impact of foreign development assistance on economic growth, and construction industry development; (x) effective public-private and foreign-local partnerships; and (xi) effective technology and knowledge flows.

## CONCLUSION

Despite the debate on their appropriateness, the MDGs are relevant goals which provide a framework and benchmarks for the development effort in African countries. The task of attaining the MDGs is immense and the time is short. The poorest countries are in a group of 35 “Low-income Countries Under Stress” which “are home to almost 500 million people, roughly half of whom live on less than a dollar a day. These countries face poor governance, conflict or post-conflict transitions, and a multiplicity of problems that make the achievement of development results particularly challenging” (IEG, 2006: 18). Many of these countries are in Africa.

The construction industry has a critical role to play in efforts to attain the MDGs. The industry should provide value for money for society by producing cost effective, high quality, durable and easy to maintain buildings and items of infrastructure in the most time efficient and sustainable manner. It should use procurement and project management approaches that enable construction activities to provide the maximum stimulus and spin-offs in the local economy, and employment opportunities for the community.

Researchers in construction and the built environment should give priority in their work to how the construction industry can be enabled to help realise the MDGs. A strong partnership should also be established in each country among industry, government, the community and researchers to pursue the development of a strong and efficient construction industry. There should also be a global partnership among researchers and practitioners to engender the development of the construction industries in developing countries.

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# HANDMAIDENS AND IVORY TOWERS: THE ROLE AND RESPONSIBILITY OF CONSTRUCTION MANAGEMENT RESEARCHERS AS AGENTS OF CHANGE

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The aim of this presentation is to explore the role(s) of construction management (CM) academics as agents of change and to highlight some of the issues involved in producing both relevant and rigorous research outputs.

It would be naïve to assume that researchers in construction management share the same ontological and epistemological perspectives regarding the methods they mobilise and the products that their work generates. One important distinction is that between rational/instrumental modes of research rooted in the sciences and engineering ‘the engineering model’ and more subjective and qualitative approaches appropriated from disciplines such as sociology ‘the enlightenment model’. The engineering model positions research as revealing something ‘true’ about the world. The intention is that by revealing something of reality, tools to help can be developed and implemented to predict, improve or exploit it. In other words, research is considered to develop new policies, techniques and forms of practice or evaluates how well they work. In terms of this model the findings of CM research are to be applied and implemented and the expectation is that they will be widely applicable in predictable ways with identifiable and beneficial results. This goes equally for research on the strength of particular materials as it does for economic modelling of construction processes. By contrast, the enlightenment model eschews the notion of a single objective reality in favour of seeking to understand how different realities and perspectives are locally constituted. This sort of research targets how meaning and values are derived, how the interactions between actors and material artefacts develop as they occur, and the practices and ideas that emerge from them. Any claims for the utility and applicability of knowledge or insights generated from this type of research would tend to be more modest than those within the harder engineering paradigm. There is little expectation of wide generalisability or easily transferable results. As an applied field construction management is populated by researchers subscribing to both of these ‘models’. Accordingly there is no reason to expect universal agreement over how the products of research contribute to academic or practitioner knowledge. It serves little purpose to go into a lengthy discussion here regarding whether this diversity is a good or a bad thing. What is important though is to distinguish between the two. Failure to do so can lead to attempts to ascribe importance and relevance to research outputs in contexts in which they have little bearing. CM academics have a responsibility to make clear what can and cannot be concluded from their research findings.

Any discussion on the role of CM research in shaping and developing an agenda for change in the construction sector must be grounded in that research outputs could benefit individuals, single firms, sectors, ‘industry’ as a whole, ‘the economy’ or ‘society’ at large. The products of research and the beneficiaries thereof cannot

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therefore be conceptualised as unidirectional or symmetrical. At each of these levels multiple perspectives co-exist. This can lead to a host of philosophical and ethical problems. There is, for example, a need to acknowledge and discuss the implications of academic research offering advantage to one constituency at the expense of another. Indeed, questions remain over who the ultimate beneficiaries of research are supposed to be and who might be denied any advantage gleaned. The position taken here is that for CM scholars to impact on the construction sector there is a need to go beyond mere academic accommodation of, and orientation toward, industry needs. This involves challenging business and societal expectations and requires a process of mutual re-alignment of research aims and objectives. The importance of producing academic insights that are relevant partly because they are not constrained by the immediate pressures of business or policy cannot be stressed enough.

It is clear that the criteria that CM researchers need to align with are different between the landscapes of academia and industry. Within academia, established reputational sources of credibility are underpinned by a disciplinary structuring of knowledge and peer review. As such, judgements of academic outputs revolve around more or less internally consistent and relatively homogenous structures. The status of research outside academia is much more heterogeneous. Credibility is conferred by multiple external groups, including research funders, industry spokespersons, practitioners and at times 'the man on the street'. In general, credibility comes from the practical implications of the research outputs. Particular importance is given to its utility as a resource for controlling, influencing or understanding business arenas. However, the relevance of, for example, a best practice guide is easy to ascribe if the engineering model is the perspective taken. Judging relevance from an enlightenment model perspective involves a more involved discussion of the sorts of contexts in which the generated research output has to make sense. The relevance of research should be judged on the basis of how well research outputs are able satisfy plural demands and gain credibility in different locations. Relevance should not be equated to the narrow ability to solve industry problems.

It is worth pointing out that academic research is just one possible route to new knowledge production, with others typically including consultancy, training, and using the skills of in-house staff. Academics are best off not trying to fill all the roles.

It should not be forgotten that research is not the only, or even the main, activity of universities, either practically or economically. Teaching is central to a university's success, and competition for attracting students is fierce. This brings with it inconsistent demands regarding the focus of research and dissemination of outputs. Academic teachers and researchers are expected to respond to new and emerging problems and to engage with current non-academic priorities. At the same time, academic institutions are expected to provide a relatively stable platform of knowledge (i.e. text-book learning) in digestible chunks, which informs and sometimes even constitutes the activities, problems and contexts of 'construction' and 'construction management'. There are tensions between training students to become effective practitioners, and to provide an academic education.

What I would want to argue for is the introduction of more critical perspectives to research in CM. Within the academic community criticism is most legitimate in the context of assessing the rigour and validity of knowledge claims put forward as contributions to disciplinary development. Most researchers should during the course of their work both be critics and be criticised. If researchers have reasonable doubts

about the validity of knowledge claims made by others then they should put forward, and justify, their criticisms. However, such criticism should not be proffered just for the sake of being 'critical' in some ontological or generic sense, or to discredit individual researchers or specific lines of argument or perspectives being pursued. Criticism is a means and not an end. It facilitates the possibility for collective production of new ideas, approaches and practices, and most importantly it helps to recognise the limitations of all forms of research and the possibility of alternatives. CM academics can also play an important role outside the academic community in questioning and criticising professionals and policy makers. Critical perspectives can encourage practitioners to reflect on their own actions and assumptions, in order to better judge their expedience and to consider other ways of thinking and acting. It could also encourage them to take seriously a broader range of considerations than those that their professional perspectives might encourage. Through more actively engaging in critical research CM academics can play an important role in counterbalancing tendencies towards inertia and self-interest in organisations of all kinds. This is equally true in terms of criticism of policies and policymakers. Through offering critique of the factual assumptions on which policies are based academics can make valuable contributions to policy. Value can also be derived from drawing attention to the assumptions relating to the consequences that are likely to follow from various actions and the likely effects on relevant agents. However, it is important to remember that the effects of criticism might not always be beneficial. Policies and practices cannot be completely separated from judgements regarding their desirability. Commonly they are the results of trade-offs between a host of perceived values, different perspectives and political fashions. Thus, whilst a very strong case can be made for a more active engagement in public sphere by CM academics there is also reason to be cautious in giving specific research outputs too much weight!





# WRITING A SCIENTIFIC ARTICLE

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Regardless of the stage of your career, the ability to write papers for publication is a crucial part of your toolkit as a researcher and academic. But it is not something which necessarily comes easily, or quickly, but rather a skill which needs to be developed and which improves over time and with practice. Whilst there is no single ‘winning formula’ - different audiences and outlets require different formats and ways of presenting your research - there are some rules of thumb which can serve to focus your writing and make a paper flow.

The aims for the workshop are:

- To describe some of techniques you can use to improve your writing skills
- Gain more understanding of the format and structure of scientific papers through analysing published work
- Reflect on the writing process and the key challenges of both producing high quality work, and getting papers published

In the session we will first look at some more general tricks and tips which are useful in developing your writing skills. Secondly we deconstruct the format of an article, and look in detail at specific aspects of structure and content which can be applied across different types of article. The final part of the session will take the form of questions and discussion around some of the particular aspects of writing scientific papers that you may be facing.

Writing is a journey which extends right across our careers. It is a necessity, but should also be a rewarding and enjoyable process.

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## **SECTION 2: CONFERENCE PAPERS**



# A FACTORAL STUDY OF ACCESSIBILITY REQUIREMENTS OF PARAPLEGICS MOBILITY IN A BUILT UP ENVIROMENT

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Whereas the growing public concern about the need for design and development of paraplegics' mobility aids such as wheelchairs and monocoques had received considerable attention of researchers world-wide in recent years, and whereas in the industrialized nations these efforts have evolved into well-planned, built-up environment suitable for use of the aids; elsewhere, especially in Nigeria, the issue appears to have remained a daunting challenge. This paper seeks to examine various variables that hinder or facilitate paraplegics accessibility to public buildings in Nigeria, especially storey buildings, up to the point of service delivery. To address this problem, this study introduced a survey approach, incorporating the method of Rensis Likert's attitudinal scale, to generate respondents' data matrix that was analysed with Principal Component Analysis (PCA) using statistiXL software. Spectacularly, our model clustered the gamut of variables, each weilding significant loading on a factor, into nine distinct factors which were creatively labeled: accessibility enhancers, inclusive design legislation, mobility difficulties, utility of mobility aids, user-friendliness of systems, utility of monocoque, social welfarism, helpfulness of inclusive design and, person centricity design. Furthermore, our findings provide support for the notion that the proposed monocoque is an imperative. The paper concludes by suggesting that the outcome of this research is needful and helpful to Town Planners, Architects, Human Factors Engineers (Ergonomists), Civil Engineers, Social Workers and, especially the Council for the Regulation of Engineering in Nigeria (COREN), in our society's effort to whittle down the perceived mobility challenges of the paraplegics in Nigeria.

Keywords: paraplegic, monocoque, ramp, built-up environment, caregiver, surrogate-variable.

## INTRODUCTION

The design of public sidewalks and buildings in Nigeria appears to have been made without due consideration to the demands of the disabled, especially those with lower limb deformity (paraplegics). This apparent oversight and lapse in judgement on the part of Government has made it quite difficult for paraplegics in Nigeria to access public buildings up to the point of service provision such as acquiring education in public schools, seeking health care in public hospitals, play or watch games in stadia, moving in streets without the assistance of caregivers. The problem posed by the seeming negligence adversely affect mobility of about 23 persons per 1000 population in major cities in Nigeria including the Federal Capital Territory (Abuja) which has the least population of disabled (Odufuwa, 2007). Evidently, the population of

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paraplegics in Nigeria is statistically significant that due attention need be given to their plight by adopting inclusive design in built-up environment.

A literature review demonstrates that many authors have used qualitative methods, percentage distribution, correlation and regression statistical techniques, see, for example, Hamza and Dada (2005) as well as Odufuwa. The proposed approach, besides presenting model inclusive designs that meet all kinds of users requirements for both public sidewalks and buildings, identified the key factors that hinder or enhance mobility of paraplegics. The factors were subsequently transformed into metric variables to facilitate mathematical tractability. The approach further employed PCA to summarize or reduce the large number of scale items (variables) affecting paraplegics into fewer dimensions (factors,  $F_j : j = 1, 2, \dots, 9$ ) to achieve parsimony. The factors were creatively labeled, interpreted and used as decision support tools for policy development.

Odufuwa thereof noted that it is unconscionable that despite the high rate of population of disabled persons in Nigerian cities, the government and citizens offer little or no promise to this less privileged group, stressing that it is becoming increasingly difficult for the disabled in Nigeria to have a sustainable livelihood. He attributed the hardship, to a large extent, to their inability to have access to basic facilities.

Although the literature about the welfare of paraplegics in Nigeria is deficient, elsewhere numerous authors have documented assistive technology for user group that includes disabled and older people. It is generally believed that accessibility is a key transportation element and is a direct expression of mobility either in terms of people, freight or information (Rodrique, 2004). Moreover, a number of studies (Focas, 2000; Huby and Burkitt, 2000; Shucksmith, 2000 and Trac, 2000) argued that inability to access transport can lead to people missing out jobs, education and other social opportunities.

Also, various studies had examined users' perception of wheel chair styling, design features and their appeal. Some of the relevant studies include: Thomas (2001), Newell (2003), Pockney (2003), Bennington et al (2003), Keates and Clarkson (2002), Gheerawo and Cassim (2003), Pockney (2003), Porter (2003), Browning et al (1996), Close (2001), Cassim (2003a, 2003b), Allen (2004), Field (2003), Pockney (1999), Barber (1996), Warwick and Cavallaro in Kennington edition (1998).

The aim of this study therefore is to provide design guidelines for inclusive designs in sidewalks and hallways leading to public buildings. The study also aims at using the PCA statistical technique to abstract, from a gamut of factors, the surrogate variables that would be helpful in carrying out concurrent (simultaneous) engineering design in the course of development of ramps, hallways, mobility aids in order to achieve paraplegic centricity. Perhaps in no other modeling endeavour is the use of PCA seen more than in data reduction and summary which is most helpful in policy development. To achieve such result is beyond the scope of unsophisticated techniques.

## METHOD

This action research was carried out in Nigeria which is a West African Country having a population of about 140 million with an associated annual growth rate of 2.8% spanning over 350 ethnic groups (NPC, 2006 and Pyke et al, 2003). The target population for this study are the paraplegics in Nigerian cities. For the survey aspect

of the study, Edo state was used as a purposive sample. The state is located at the transit nerve centre of the nation and that is exactly why it is referred to as the ‘heart beat of the nation’. Many ethnic nationalities reside there including foreigners. A random sample of 10 paraplegics and forty persons from academia were administered with questionnaires crafted with twenty one (21) scale items (variables) describing attributes relating to fitting job to paraplegics (FJP) in sharp contrast to the present Procrustean approach of fitting paraplegics to job (FPJ). The scale items are detailed in Table 1. The target respondents were briefed and debriefed before and after the administration of the instruments respectively to assess content validity.

Table 1: Twenty-one scale items (variables) on accessibility and mobility of paraplegics

Item No	Scale Item	Item No	Scale Item	Item No	Scale Item
1	Usefulness of monocoque	8	Unavailability of ramps	15	Alternative power supply cost
2	Usefulness of built environment	9	Utility of electric wheelchair	16	Effectiveness of ramp-handrails
3	Utility of monocoques	10	Panacea to paraplegic challenges	17	Accessibility restrictions impacts
4	Consequences of mobility limitations	11	Standard ramp design	18	Accessibility of built-up-environment
5	Usefulness of assistive technology	12	Usefulness of anthropometric data	19	Government lip-service
6	Importance of inclusive design	13	Wheelchairs user-unfriendliness	20	Difficulties in hand rim propulsion
7	Effective legislation towards inclusive design	14	Dearth of ramps	21	Power failure induced inoperability

The questionnaire was scaled with 7–point Rensis Likert’s attitudinal scale which enabled respondents’ response options to be transformed into metric variables that measure the degree of possession of attributes. These were subsequently collated as data matrix which served as input to the PCA that followed. StatistiXL software was used to generate correlation matrix, factor matrix, parameter estimates. Surrogate variables were highlighted from the factor matrix which yielded 9 factors. The unrotated factor space earlier obtained could not lend itself to easy interpretation and so varimax rotation became expedient. We did this because we already know that we are at liberty to make any linear transformation of the factor space without affecting the fit of the model. Thus, since the factor solutions are orthogonal, the factors are independent. Factor loadings in the factor matrix showing remarkable departure from 0.500 were disregarded. Moreover, latent root criterion was applied. It requires that any individual factor account for the variance of at least a single variable if it is to be retained for interpretation.

It is important to observe that factorability of the correlation matrix was examined by visual inspection of the correlation matrix. It revealed substantial number of

correlations greater than 0.30 thus suggesting that the PCA is applicable. The following assumptions about Factor Analysis were made:

There were no departures from :

- normality (shape of data distribution for individual metric variable)
- homoscedasticity (equal dispersion of variance across variables), and
- linearity (columns of data matrix are seen as column vectors with linear characteristics), which can diminish correlation.

Finally, the model design of hallways and ramps were carried out by making reference to Human Factors Design Handbook (Woodson, Tillman and Tillman)

## RESULTS

Table 2 shows the unrotated factor solution space. Nine orthogonal factors were extracted. By examining the unrotated factor matrix we note the need for a factor matrix rotation. Accordingly, Table 3 depicts the varimax rotated factor loadings.

Table 2: Unrotated factor loadings

Variable No	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Communalities
1	0.273	-0.143	0.213	-0.159	0.478	-0.135	-0.611	-0.156	-0.298	0.898
2	0.208	-0.225	-0.202	0.018	-0.192	0.724	0.058	-0.111	0.444	0.909
3	0.566	0.019	-0.145	0.400	-0.230	0.333	0.233	0.209	-0.348	0.886
4	0.454	-0.366	-0.360	0.146	0.305	0.109	-0.243	-0.035	0.382	0.803
5	-0.177	0.260	0.586	-0.502	-0.250	0.149	0.212	-0.032	0.261	0.893
6	-0.212	-0.069	0.332	-0.479	0.028	0.206	-0.342	0.513	0.086	0.821
7	0.620	-0.421	0.201	0.045	0.294	0.432	-0.164	-0.002	-0.043	0.905
8	0.481	0.112	0.304	0.576	0.101	-0.098	-0.180	0.379	0.136	0.882
9	0.369	0.357	0.597	0.184	-0.036	-0.226	-0.053	-0.296	0.174	0.827
10	-0.252	-0.422	0.669	-0.006	-0.133	0.371	0.047	-0.221	-0.243	0.955
11	0.493	0.532	0.108	-0.465	0.034	0.167	-0.098	-0.263	-0.062	0.866
12	0.382	0.142	0.550	0.169	0.201	0.209	0.368	0.007	-0.219	0.764
13	0.463	-0.280	0.376	-0.159	-0.316	-0.297	-0.234	0.157	0.269	0.799
14	0.059	0.304	0.220	0.107	0.660	-0.207	0.396	-0.044	0.255	0.858
15	0.608	0.571	-0.125	-0.060	-0.250	0.037	-0.018	0.179	-0.150	0.833
16	-0.008	-0.384	0.125	-0.289	0.256	-0.087	0.360	0.637	-0.039	0.858
17	0.514	-0.164	-0.333	-0.621	0.165	-0.105	0.121	-0.058	-0.211	0.888
18	0.349	-0.675	0.173	0.093	-0.105	-0.384	0.288	-0.157	0.067	0.886
19	-0.051	0.738	-0.146	-0.081	0.511	0.226	0.075	0.079	0.126	0.914
20	0.433	-0.457	-0.203	-0.357	0.155	-0.047	0.325	-0.181	0.062	0.734
21	0.669	0.362	-0.151	-0.172	-0.462	-0.211	0.036	0.088	0.063	0.902



Factor loading in the factor matrix that are considered as middling (neighbourhood of 0.500), substantial (neighbourhood of 0.700) and meritorious (neighbourhood of 0.900) were highlighted, retained and interpreted. Table 4 shows the eigenvalue.

Table 3: Varimax rotated factor loadings

Variable No	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Communalities
1	-0.049	0.062	-0.091	0.092	-0.043	-0.934	0.028	-0.005	-0.008	0.898
2	-0.012	-0.876	-0.075	-0.119	0.059	0.249	-0.200	-0.082	-0.104	0.909
3	0.387	-0.181	0.018	0.352	-0.017	0.183	-0.206	-0.024	-0.708	0.886
4	0.051	-0.673	-0.137	0.449	-0.167	-0.244	0.142	0.008	0.136	0.803
5	0.051	0.056	0.028	-0.918	0.004	0.148	0.095	0.114	0.019	0.893
6	-0.048	-0.061	0.170	-0.430	0.117	-0.279	-0.209	0.661	0.169	0.821
7	-0.015	-0.576	-0.149	0.081	-0.190	-0.495	0.004	0.128	-0.497	0.905
8	0.327	-0.146	0.582	0.278	-0.261	-0.203	0.317	0.136	-0.332	0.882
9	0.297	0.081	0.309	-0.347	-0.291	-0.244	0.435	-0.381	-0.194	0.827
10	-0.591	0.000	0.085	-0.499	-0.226	-0.128	-0.284	-0.031	-0.448	0.955
11	0.576	-0.069	-0.279	-0.419	0.283	-0.343	0.114	-0.226	-0.116	0.866
12	0.066	0.032	0.029	-0.213	-0.042	-0.093	0.353	0.013	-0.760	0.764
13	0.345	-0.135	0.099	-0.220	-0.708	-0.242	-0.040	0.191	0.080	0.799
14	-0.079	0.083	-0.035	-0.015	0.132	-0.002	0.904	0.027	-0.092	0.858
15	0.861	0.022	0.007	0.013	0.174	-0.018	-0.029	-0.060	-0.238	0.833
16	-0.143	0.084	-0.248	0.024	-0.168	0.100	0.147	0.831	-0.132	0.858
17	0.339	-0.037	-0.827	0.080	-0.044	-0.235	-0.031	0.156	0.010	0.888
18	-0.135	-0.038	-0.292	0.131	-0.853	0.043	0.104	-0.019	-0.152	0.886
19	0.206	-0.036	0.043	-0.053	0.786	-0.022	0.496	0.021	0.037	0.914
20	0.022	-0.263	-0.733	0.076	-0.316	-0.017	0.112	0.072	-0.058	0.734
21	0.909	-0.009	-0.117	-0.042	-0.197	0.097	-0.045	-0.100	-0.014	0.902

We note that eigenvalue of unity ( $\lambda=1$ ) set the threshold for determining the candidacy of variables to be retained in the factor space. Figure 1 depicts standard design for

public sidewalk (hallway) while figures 2a, 2b, 2c, 2d and 2e show standard ramp design specification for Monocoque users.

Table 4: Explained variance (eigenvalues)

Value	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9
Eigenvalue	3.537	3.089	2.388	1.982	1.832	1.583	1.414	1.235	1.024
% of Var.	16.843	14.710	11.372	9.438	8.721	7.539	6.733	5.880	4.878
Cum. %	16.843	31.553	42.925	52.363	61.084	68.623	75.357	81.237	86.114
Value	Factor 10	Factor 11	Factor 12	Factor 13	Factor 14	Factor 15	Factor 16	Factor 17	Factor 18
Eigenvalue	0.728	0.657	0.487	0.463	0.221	0.207	0.076	0.056	0.020
% of Var.	3.467	3.130	2.319	2.206	1.052	0.985	0.364	0.265	0.093
Cum. %	89.581	92.711	95.030	97.237	98.289	99.274	99.637	99.902	99.996
Value	Factor 19	Factor 20	Factor 21						
Eigenvalue	0.001	0.000	0.000						
% of Var.	0.004	0.000	0.000						
Cum. %	100.000	100.000	100.000						

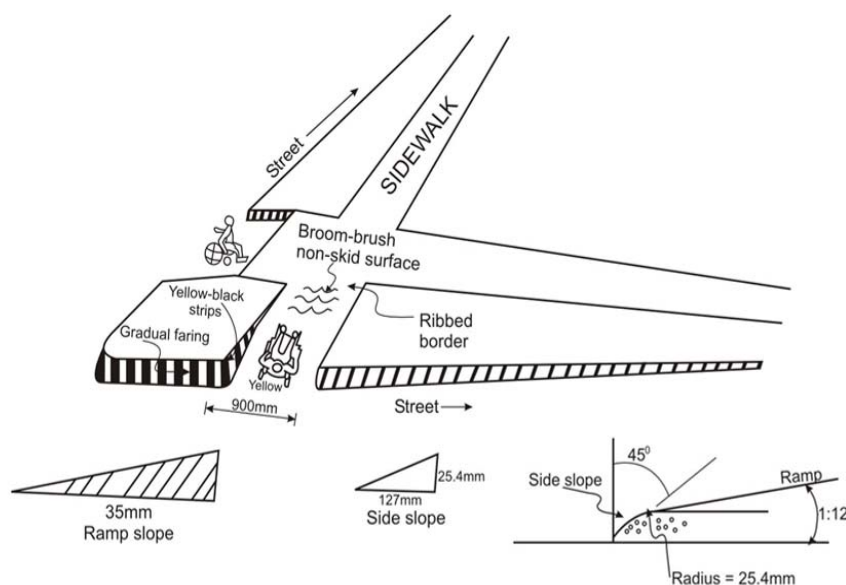


Figure 1: Wheelchair/monocoque Ramp Design in a Built-up Environment

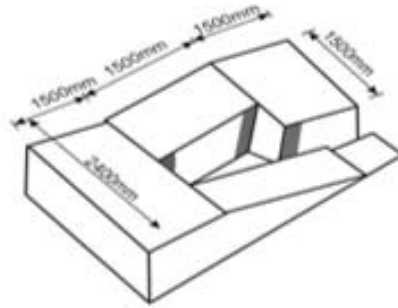


Figure 2(a): Ramp

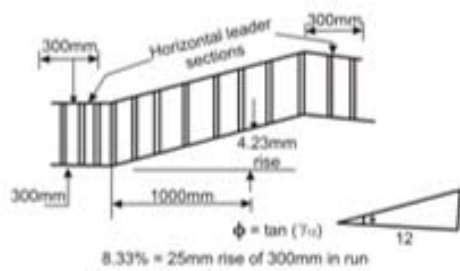


Figure 2(b): Railing Design

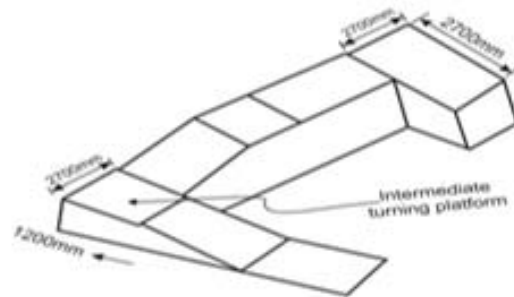


Figure 2 (c): Straight Run Ramp

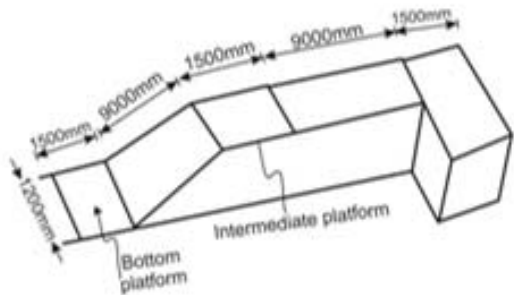


Figure 2(d) Straight Run Ramp

Moreover, the PCA analysis applied loaded the variables under nine (9) factors by varimax rotation scheme. Interestingly, the application of latent root criteria and scree plot (shown in figure 3) suggested that the nine factors meet the requirements for factorability and interpretability.

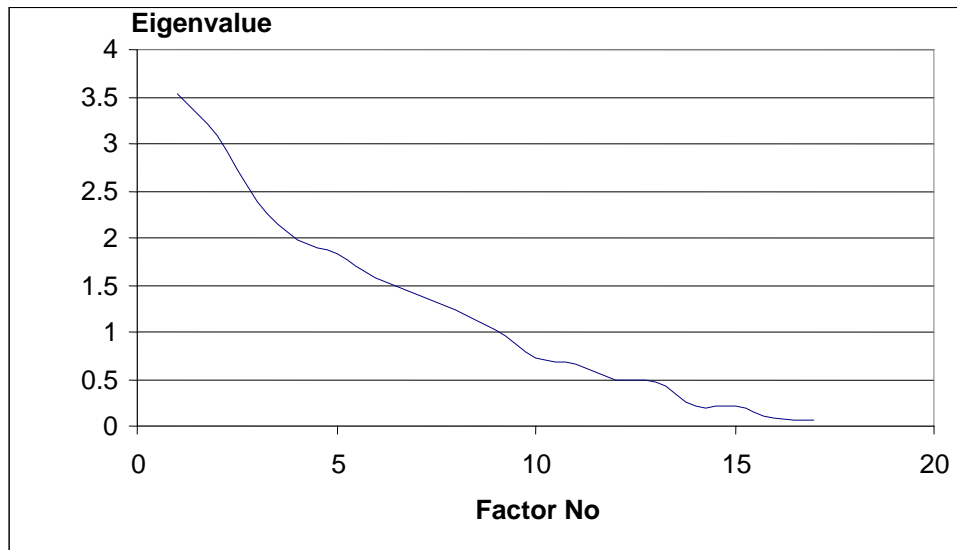


Figure 3: Scree Plot

The nine factors and their creative labels are depicted in Table 5.

**Table 5: Factors Platoons**

(i) Cluster I ( $F_1$ ): Accessibility enhancers

Variable Number	Factor Loading	Variables
21	0.909	Power failure induced inoperability
15	0.861	Alternative power supply cost
10	-0.591	Monocoque as panacea to paraplegic challenges
11	0.576	Standard ramp design

This is a bipolar factor and the magnitude of factor loadings of variables is insightful to the significance of each variable. The higher the loading, the more, the influence of the variable, on the factor. Accordingly, power failure is the most offensive variable followed by alternative power supply cost.

(ii) Cluster II ( $F_2$ ): Inclusive design legislation

Variable Number	Factor Loading	Variables
2	-0.876	Usefulness of built environment
4	-0.673	Consequences of mobility limitations
7	-0.576	Effective legislation towards inclusive design

The remaining two variables are middlings. In this regime, the variables, all weild negative factor loadings suggesting nonexistence up-to-date. We are aware that Nigeria is yet to legislate on inclusive design in public buildings.

(iii) Cluster III ( $F_3$ ): Mobility difficulties

Variable Number	Factor Loading	Variables
17	0.827	Accessibility restriction impact
20	-0.733	Difficulties in hand rim propulsion
8	0.582	Unavailability of ramps

This is another bipolar factor stressing the need to pay greater attention to accessibility restriction by virtue of its meritorious factor loading (0.827). variable 20, reason of negative substantial loading, portrays the labour intensiveness of hand rim propulsion. The last factor, a middling, underscores the importance of standard ramps in built up environment. Although nonexistent on account of the negative sign, the magnitude of the loading demonstrative of its importance.

(iv) Cluster IV (F<sub>4</sub>): Utility of mobility aids

Variable Number	Factor Loading	Variables
5	-0.918	Usefulness of assistive technologies

(v) Cluster V (F<sub>5</sub>): User-friendliness of systems

Variable Number	Factor Loading	Variables
18	-0.853	Accessibility of built up environment
13	-0.708	Wheelchair user-friendliness

The two notions (variables 18 and 13) weilding substantial negative loadings are yet to be realized. Our result suggests that ramps and walk ways should be developed first, then the proposed wheelchairs/monocoque would find relevance.

(vi) Cluster VI (F<sub>6</sub>): Utility of Monocoque

Variable Number	Factor Loading	Variables
1	-0.934	Usefulness of monocoque

This result shows that, with the highest factor loading amongst the platoons, the proposed monocoque would engender inestemable benefits to the paraplegics.

(vii) Cluster VII (F<sub>7</sub>): Social welfarism

Variable Number	Factor Loading	Variables
14	0.904	Dearth of ramps
19	0.496	Government lip services
9	0.435	Utility of electric wheelchair

This represents a sturdy factor unscoring the need to provide ramps in public buildings and walkways. The mediocre loadings on the rest variables suggest that, to some extent, government is insincere in dealing with the accessibility constraints.

(viii) Cluster VIII (F<sub>8</sub>): Helpfulness of inclusive design

Variable Number	Factor Loading	Variables
16	0.831	Effectiveness of Ramp-handrails
6	0.661	Importance of inclusive design.

Ramp-handrail is meritoriously loaded under F<sub>8</sub> thereby showing its significance in the design of public buildings. The next variable, inclusive design, is moderately loaded thus indicating its level of importance in design considerations.

Variable Number	Factor Loading	Variables
12	-0.760	Usefulness of anthropometric data.
3	-0.708	Standard ramp design.
(viii) Cluster IX (F <sub>9</sub> ): Person-centricity design		

These negative variables are substantially loaded under F<sub>9</sub>. The factor illustrates that the ideal thing in design is to apply anthropometric data in the determination of ramp dimensions. In each of the nine platoons presented in the foregoing, it is evident that the scale items (variables) were depicted in the descending order of their factor loading. The magnitude of the factor loading represents the level of importance of the variables in relative terms.

### Factor interpretations and policy formulation

Our results have shown that clusters 1, 7 and 8, namely accessibility enhancers, social welfarism and helpfulness of inclusive design are of top priority. The loading under **F<sub>7</sub>** and **F<sub>8</sub>** are all positive and the absolute values are also substantial suggesting their relevance as policy elements. Factor 1 is a bi-polar factor because variable 10 has a negative factor loading of **-0.591**. The negative sign means that it varies inversely with the factor (accessibility enhanced facilities).

The monocoque is not yet in existence, and so the respondents felt that the more monocoques that are introduced to paraplegics, the lesser their challenges, and the challenges are the inaccessibility of facilities. Under the same Factor 1, the PCA model trumped power failure as the most offensive variable that makes systems not to work; this suggest that policy makers should give greater emphasis to scale item number 21.

Variable 15, alternative power supply cost is substantially loaded under **F<sub>1</sub>** thereby suggesting that it is a key issue especially when public power supply system fails. The import is that, like in developed countries, the proposed monocoque will work better if power is always available to operate lifts. Monocoque or wheelchair can easily take paraplegics to various floors of high rise buildings. The wheelchair or Monocoque can then take the paraplegic to the point of service provision on the floor in question. The last variable under **F<sub>1</sub>** is a middling, i.e. standard ramp design. It suggests that when ramp is designed and constructed in line with international standard, it lends itself to user-friendliness in accessing high rise buildings.

Under factor 7, social welfarism, the respondents are in complete agreement that there is dearth of ramps in public buildings in Nigeria. It is a reflection of Government's lack of empathy for the paraplegics (variable 19). They pay lip service only, but there is no action oriented programmes to address their plight. Loading on variable 9, utility of electric wheelchair is a mediocre because the variable wields a factor loading of 0.435. The respondents felt that introduction of wheelchair whose operation will use electricity would be a futile venture probably because power might not be readily available. It is therefore a poor policy element. The next important factor platoon is **F<sub>8</sub>** (Helpfulness of inclusive design). Variable 16 (effectiveness of ramp handrail) has a meritorious loading of 0.831 while variable 6 (importance of inclusive design) has a substantial loading thus stressing that it is necessary to adopt inclusive design in built-up environment.

The next group of clusters are:

**F<sub>2</sub>** : Inclusive design regulations

**F<sub>4</sub>:** Utility of assistive aids  
**F<sub>5</sub>:** User-friendliness of systems  
**F<sub>6</sub>:** Utility of Monocoque  
**F<sub>9</sub>:** Person-centricity Design

All variables under these factors wield negative factor loadings.

The foregoing factors are orthogonal and therefore are independent of one another. The signs only bear meaning on the factor they are loaded. The magnitude, as well as the sign of the loadings bear significance. The higher the magnitude of loading, the more the influence of the variable loaded. The negative signs signify that all the attributes described by the variables are futuristic in terms of realization; they are yet to take effect. The respondents feel that when effective, the degree of influence would be reflective of the magnitude of their factor loadings.

## **DISCUSSION**

The survey approach adopted was effective in articulating the factors that are relevant to addressing the mobility demands of paraplegics. Moreover the PCA model employed enable us to achieve parsimony in data reduction. The twenty one variables identified were factorized under nine main factors. In this regard, it is easier for policy makers to hatch plans resolving around these nine platoons instead of having to deal with the twenty separate variables. Concerning the structure of the variables, there are clearly nine (9) separate and distinct dimensions (clusters) for evaluating the challenges paraplegics in Nigeria face in having access to built-up environment. Designers of Hallways, walkways and sidewalks in Nigeria may thus adopt the designs in order to improve the perceived accessibility hindrances in built-up environment.

It is evident from our results that four variables wield meritorious factor loadings. These comprise: power failure, utility of mobility aids, usefulness of monocoque and dearth of ramps. These variables are critical to solving the mobility problems of the paraplegics in Nigeria.

PCA applied has also provided the basis for data reduction or clustering through varimax rotation. Perhaps it should be noted that there are complex inter-relationships represented in the factor matrix (Table 2), and their interpretation is subtle.

## **CONCLUSION**

Taken together, it is the view of the authors that if power supply can be readily available in taking wheelchairs and Monocoque to points of service provision. At present, cost of operation of standby generator to operate lift is outrageously high due to high cost of diesel (N100 per litre). It is also believed that assistive technology would be beneficial but Nigeria lack the necessary infrastructure for these now. The study strongly recommends the use of the proposed Monocoque (the highest factor loadings). There is consensus that the need for provision of ramps in public buildings has not received serious attention from Government. A model design has been developed as guide to planners.

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# A HEDONIC REGRESSION ANALYSIS OF URBAN INFRASTRUCTURE IN COMMERCIAL PROPERTY VALUES IN LAGOS

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Studies have revealed the importance of infrastructure on real estate, the capacity for economic stability as well as on the ability of industries to compete in international markets amongst other factors. However, urban areas in developing countries trail the world in the quantity and quality of their public services. In spite of substantial investments made, the delivery of these services continues to be plagued by problems that have existed for many years. The condition of infrastructure facilities is poor and the financing strategies are inadequate. The study will investigate with a hedonic regression model, economic influences of various infrastructure types on commercial property values within the study areas. The need to improve the adequacy of infrastructure in developing countries justifies a focused treatment of financing instruments, as well as requirements of strategy and regulations specific to emerging economies. Infrastructure delivery should be tailored to suit the economic and financial capacity of each region. This is in order to recover its investment costs from subsequent gains in property values as a result of the provision and improvement of urban public services. More simply put, costs of infrastructure delivery should be recovered from betterment levies and taxes by the extent to which infrastructure provision may have influenced the value of properties. As such, public investment decisions can be facilitated. The sample size utilized will be at least 40% of the population of real estate practitioners and commercial building users within the study area. Data collection will be based primarily on property values, willingness to pay for public services, and environmental/location characteristics through questionnaires and interviews. The hedonic regression model is expected to reveal the relative impact of each infrastructure type on commercial property values within the study areas.

Keywords: commercial property, developing country, finance, hedonic valuation, infrastructure.

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# ADAPTABLE AND FLEXIBLE DESIGN SOLUTIONS TO THE SPATIAL QUALITY OF PUBLIC APARTMENT BUILDINGS IN GHANA: A RESEARCH AGENDA

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The need to make buildings flexible and adaptable as a means of improving spatial quality over time has long been recognized. The strategy however, still remains marginal to the design profession. While some attribute the situation to shortfalls in the assumptions which underlie designs, others point to challenges with the techniques to achieve such ends. In essence, however, to make designs adaptable and flexible is to remove or reduce the extent of constraints imposed on it in order to facilitate change possibilities over time. The purpose of this paper is to present a research agenda which seeks to develop a methodology to assess the requirements for flexibility and adaptability in the design of the space plan of apartment dwellings in order to provide guidelines for design decision making. By means of extensive review of literature, the paper examines the gaps in knowledge and consequently highlights the need for research. A theoretical/conceptual framework for research is presented in addition to an approach to study design. The paper argues that a building's spatial quality over time depends on the extent of flexibility and adaptability in design, which is a function of how effectively design translates and integrates user requirements. To achieve spatial quality therefore is to adopt designs which limit the extent of constraints imposed on the flexibility and adaptability by the building. The paper contributes to understanding the nature and extent of the gaps in knowledge regarding the methods for improving the spatial quality of buildings, and dwellings in particular, and how this can be bridged through relevant scientific research.

Keywords: flexibility, adaptability, functional quality, functional requirement, design attribute

## INTRODUCTION

A house is to all a basic human need. The mismatch between demand and supply, however, continues to increase both in quantity and quality, the world over. In developing countries the challenge is more pronounced. For example, current estimates of housing shortage in Ghana is in excess of 500,000 units whilst supply varies between 25,000 and 40,000 units as against an annual requirement of 70,000 (MWRWH, 2005). Beyond quantitative deficits, the quality of houses is also a concern to individuals and governments alike, primarily because buildings in general affect the quality of human life in many significant ways such health, comfort and productivity (Halpern, 1995; Leaman and Bordass, 1999; Bonnefoy *et al.*, 2007). For

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dwelling houses, this is even more significant because an estimated 60-85% of a lifetime is spent in dwellings, with half of this period in bedrooms (Hasselaar, 2009).

Quality in housing, however, presents different interpretations and challenges to different decision-makers. For human development and social policy, the challenge is the relationship between indicators such as the number of rooms, proximity to social amenities, the availability of service amenities such as water and lighting, etc, and demographic parameters such as income and educational levels of users, household size, age, etc. Others focus on the psycho-social aspects of users' residential environment such as relationships with neighbours, neighborhood characteristics, the degree of attachment to the environment, etc (Canter and Rees, 1982; Amerigo and Aragonés, 1990). Against this background, Adriaanse (2007), proposed a Residential Environment Satisfaction Scale for evaluating the satisfaction of users of residential buildings in the Netherlands based on a Dutch National Housing Demand Survey. Similarly, Fiadwo *et al.*, (2001), developed a Housing Quality Index for policy decision in Ghana using 13 core welfare indicators.

For design and designers, the more critical challenge is the practical usability or long-term usefulness of houses in terms of indicators such as space and services efficiency achieved through a synthesis between functional requirements of users and design attributes. For example, Hofman *et al.* (2006), observe that although there is a growing interest in mass customized housing solutions, (Barlow, 1999; Barlow *et al.*, 2003; Noguchi, 2003), the prioritization of housing attributes in house design still remains unknown by house builders. Levermore (1994), observe that beyond energy performance, rarely is there any systematic analysis of occupant's opinion of building environments. Where these are measured, the author argues that it is unclear what the differences are between the relative importance of various factors as they are as design variables and how occupants perceive them. Brown and Cole (2009), note that further work is needed to understand the degree and direction to which expectations influence users' perception of comfort in building environments. For example, Vischer (1985) found that the lack of control in dwelling environment is a major precursor of disaffection among users of public apartment buildings, although it is unclear what aspects users require this control. The problem is to question the nature and extent of control required. In criticizing the extent to which flexibility as a design strategy has been brought to bear on greater user control in buildings, for example, Habraken (2008) observes that after more than a century of attempts by architects to design with flexibility in mind, the issue still remains marginal to the profession. While some suppose this is due to the failure of designers to use the stock of available knowledge (West and Emmitt, 2004), others attribute it to the fact that most of the assumptions which underlie designs are not well enough informed by what really happens in practice, because few people who design buildings go on to monitor their performance (Bordass *et al.*, 2004; Hinge *et al.*, 2008). These observations reveal significant gaps in knowledge not only with respect to the theoretical basis of design solutions but also possible shortfalls in the strategies followed in designing buildings which promise quality over time. Against this background, relevant scientific research is deemed necessary.

## **WHAT DEFINES THE SPATIAL QUALITY OF A DWELLING HOUSE?**

Quality is severally defined. From a production point of view, quality is simply 'conformance to specifications'. According to Juran (1988), quality is 'fitness for use'.

Other definitions of quality extend to include the expectation that the product or service delivered i) meets customer standards, ii) meets and fulfills customer needs, iii) meets customer expectations, and iv) will meet unanticipated future needs and aspirations (Gitlow, *et al.*, 1989; Ozeki and Asaka, 1990). This means that more critically, the quality of a product measures the extent to which it satisfies user requirements in both the short and long term.

According to Burt (1978) the quality of a building refers to “the totality of attributes that enables [it] to satisfy needs, including the way in which individual attributes are related, balanced and integrated in whole building and its surrounding”. This may be aesthetic, functional, technical or economic (Van de Voordt and van Wegen, 2005). In terms of functionality, however, the authors define quality as the extent to which the building and the constructional means [technical systems] applied make possible and provide a proper level of support for the *utility function* or the activities envisaged for it. Thus, functional quality describes the practical usability of the building over time. The more specific requirements to this end include indoor air quality, thermal comfort, acoustic comfort, visual comfort, spatial comfort and building integrity (Emmitt and Gorse, 2005). In terms of spatial comfort, therefore, the quality of a dwelling house can be described as the extent to which the provisions for space meet user requirements in the present and the future.

Hartkopf *et al.*, (1986) indicate that the quality of a building may be evaluated in terms of suitability, reliability and flexibility. According to the authors, suitability measures the degree to which a building and its components parts serve user needs in the present and the future; reliability expresses the probability that the services will continue to perform as intended throughout the life of the facility, given appropriate maintenance; while flexibility, provides a measure of the building’s ability to accommodate changing functions during its life cycle. With reference to spatial quality, suitability and flexibility can be said to be more significant. A key indicator of the suitability of dwelling houses relate to the requirements of spaces for specific uses (functions) (ISO 6241-1984 (E). Preiser (1983), indicate that suitability of space relates to the location, dimensions (size), distribution (number, type), proportion, orientation and interrelations between spaces in the building. It takes into account functions and layout to the extent that this supports habitation of people, accommodation of furniture and the execution of domestic activities. In practice, suitability may be evaluated in terms of criteria such as i) the extent to which the space plan meets changing demands, e.g. by families at different stages of development, ii) the extent to which both activities needing privacy or otherwise are effectively provide for, iii) the extent to which spaces that are convenient to have near each other are made possible in the plan, iv) the efficiency of the circulation system, v) the convenience of entry and exit from outdoors, etc (West and Emmitt, 2004). According to Habraken (2008) the purpose of flexibility in design by whatever name is to allow users control over their environment. West and Emmitt (2004) argue that one of the best ways in which variations in home life can be accommodated is to provide plan forms that allow multi-function rooms and/or a degree of flexibility in layout.

Summarized, spatial quality in terms of flexibility and suitability can be said to relate to functional, dimensional and configurational properties of the designs. In a sense, this contributes to the practical ‘usability’ of the building over time.

## **SPATIAL QUALITY AS PRACTICAL USABILITY OF THE DWELLING**

Usability describes the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction (ISO 9241-11:1998). According to this source, users refer to a person(s) who interacts with the product including current, potential and expected future users. In the case of a dwelling house the term user refers to user-occupants or tenants of the building. According to Vischer (2008), given the dynamic and interactive nature of the user-environment relation, if users indicate that environmental features or conditions support them and what they are doing, the built environment is effective and functional. In his study of '*People and Plans*' Gan (1968), observe that the effective building environment is that version of the potential environment that is manifestly or latently adopted by users. This imputes user *choice* (preferences) as being fundamental to the definition of an effective environment and hence quality. For example, Vanessa *et al.*, (2006) found that customers (users) value the opportunity to be involved in deciding several aspects regarding their dwelling environment, and as important as kitchen space. According to Vischer (1985), the effective dwelling environment is one that provides for user control and adaptation. *Control*, according to the author defines users' "ability to change physical dimensions of their environment" whereas *adaptation* allows the possibility to change behaviour in response to different environmental context if control is not possible. An example is a bedroom of such spatial capacity to allow for home working or study as these become necessary over time. In the particular case of public apartments the author found that the lack of control over the environment is a major precursor of disaffection among users. In the view of Habraken (2008), the purpose of designing for flexibility by whatever name is to enable individuals control over their environment.

Related to the requirements of users, therefore, spatial quality in terms of the practical usability of the dwelling can be defined in terms of choice in the determination of specific attributes of space, possibility for control and provisions for adaptation over time. The fundamental design challenge is how to translate these functional requirements into design attributes.

## **ADAPTABILITY AND FLEXIBILITY IN DESIGN: A STRATEGY TO ENHANCE THE SPATIAL QUALITY OF DWELLINGS**

Brown and Steadman (1991) indicate that more significantly, as buildings age, it is often the degree to which they constrain present functional requirements that is the decisive consideration, citing the degree of mismatch between spatial form and functional requirements, as an example. Duffy (1990) and Brand's (1994) model of the shearing layers of building change argues that the higher layers of shear by their rather slower rates of change constrain the lower layers which change more rapidly. Thus, the space plan for example, can suffer significant constraints from the building's skin and structure system, for example. The implication is that identifying and reducing the extent of constraint placed on the space plan of the building can greatly enhance its spatial quality over time. The shift in conceptual assumption, approach and technique, therefore, is towards a philosophy of systematization in design premised on the fact that different parts or elements of the building have different life cycles (life spans) and functional expectancies and therefore should have a status of independent part in the whole building system (Duffy, 1990; Brand, 1994; Durmisevic and Brouwers, 2002). The supposition is that the more flexible or



independent these parts are within the building's configuration, the better will be their ability to adapt to changing needs and requirements of stakeholders in both the short and long term. In this regard, the "open building" approach to design (Habraken, 1972; Habraken 2008; Kendall and Teicher, 2000) has consistently been argued for. This strategy separates the building into fixed elements (e.g. envelope walls, structural components, pipe ducts) and changeable elements (e.g. fittings and fixtures, internal partitions, etc), arguing that to the extent that the fixed elements do not unduly constrain the changeable elements the building will be functional. The goal is to reduce the extent of constraints imposed on those parts of the building which are more likely to come under change quickly as a means of enhancing building usefulness. The XX-Office project in the Netherlands is a typical case of such designs (Post and Willems, 2002)

According to Atlas and Ozsoy (1998), the *adaptability* of a building depends on how well the fixed elements are organized and dimensioned to provide variations in the configuration of the changeable elements. In this regards, the authors distinguish this attribute of a functional house from *flexibility* which is defined as the "use of space for various purposes without making physical alterations". Habraken (2008) note that "the term flexibility is used to cover the entire range of possible design decisions that aim to loosen rigid functionality". Kincaid (2002), observe that *flexibility* allows the creation of spaces within a building which have such a quality of presence that people adapt their activities to suit the building and not the building to suit their activities. The significant difference which emerge between adaptability and flexibility is that: i) adaptability of a building describes its physical and morphological features, whereas flexibility define the functional characteristics ii) adaptability involves possibilities for the actual physical alteration of the building – dimensions, form, etc; flexibility does not (Wong, 2010). A defining characteristic of both flexibility and adaptability, however, is configuration - the way parts or elements are arranged and fit together.

Significantly, therefore, to achieve spatial quality through adaptability and flexibility in dwellings is to argue for designs which limit the extent of constraints imposed on the functional, dimensional and configurational properties of the building. Research effort which seeks to examine and understand the nature and extent of these constraints in order to eliminate or reduce them through design and building technology is therefore imperative. For example, Steadman and Brown (1991), make mention of constraints that are *contingent* i.e. they are a function of external conditions over time or necessary *conditions*, i.e. they required by regulations for example.

## **TRANSLATING FUNCTIONAL REQUIREMENTS INTO DESIGN ATTRIBUTES: THE METHODOLOGY CHALLENGE**

It follows from the discussions above that if the object of adaptability and flexibility in house designs is to contribute to greater user control and adaptation, then to bring design to bear on these variables, it is important 1) to determine the priorities of users with respect to the different aspects of the dwelling environment (choice), and 2) to determine the extent of control and adaptation users demand over or make in the dwelling environment. This will reveal those aspects and attributes of the house which are more significant to users and which consequently engage their constant interaction in response to changing external conditions. Design can then focus on those attributes of the dwelling which are likely to change more quickly over time.

To this end, Post Occupancy Evaluation has been used (POE) (Zeisel, 1975; 2006). This approach equates the level of user satisfaction with the dwelling with the number of needs that users feel are met by their housing environment (Vischer, 1985). While this is useful as feedback techniques for design, the following criticisms by Vischer and others cannot be overlooked:

1. Getting users to exhaustively articulate all their spatial and design preferences through direct questioning is complex and theoretical. Humphrey (2005) observes that '*preference*' in particular may be a subtle concept emerging not so much as from the physical environment but from unknown influences, perhaps psychological;
2. The approach fails to assign priorities to users' needs (Levermore, 1994) as well as provide criteria for determining when an adequate number have been met;
3. The approach treats the user as a passive determinant in the environmental quality equation and therefore fails to recognize the active role of the user in the environment;
4. It fails to instruct research on how to trade off or balance and integrate other requirements of building design (economic, socio-political, technological, etc) with that of users.

These weaknesses put together make them insufficient and also less valid not only as aid to design but in generating knowledge of generic usefulness. Consequently, there is the need for research which extends the scope and usefulness of these methods beyond evaluation of user satisfaction to include the ways users interact with their dwelling environment in response to changing external conditions and needs. The shift is towards the ways users interact with their dwelling environment. Cole *et al.*, (2008) describes this as 'interactive adaptivity'. Vischer (1985) refers to this as the 'control and adaptation' model. The argument is that if users cannot have all their environmental preferences or even needs met (choice), how do they adapt or control their environment to ensure that they have that they attach priority, and on this basis select to forgo items of less importance? Related to public apartments, the problem then is to question: how can adaptability and flexibility in the designs contribute to enhance the spatial quality of the dwellings over time?

## RESEARCH RATIONALE

The rationale for this research may therefore be summarized as below:

- It has proven to be difficult for designers to point out exactly what requirements are the most important ones to users. The tendency is to approach the problem through the identification of technical (often durability-based) shortcomings and apply solutions accordingly (Griffin and Hauser, 1991). It seems impossible to design a building which meets user requirements over time if no research results exist on what those priorities are and why those changes occur over time;
- Existing post-occupancy evaluation techniques through direct questioning have proven limited in their ability to capture the wider range of behavioral, situational and socio-psychological measures that are known to influence how users experience buildings (Vischer, 1985; Brown and Cole, 2009).
- In the particular case of dwellings in developing countries, 'relevant contextual scientific knowledge' is important (Kohler and Hassler, 2002). This is due to the different climatic, legislative, socio-cultural and socio-economic settings, which

impact useful knowledge, rules, regulations and conventions, contextual expectations, assumptions, etc (vEgmond, 2005).

## THEORETICAL/CONCEPTUAL APPROACH

The need for theory in the study of the built environment is recognized in order to give direction to research, extend the boundaries of what is known and help diffuse knowledge (Koskela, 2008). In order to develop design solutions which meet user requirements in the present and the future, whole lifespan and evolutionary (diachronic) performance of buildings rather than a cross-sectional (synchronic) perspective is important (Duffy, 1990). This is rooted in the following observation that:

*Buildings have lives in time, and those lives are intimately connected with the lives of the people who use them. Buildings come into being at particular moments and in particular circumstances. They change and perhaps grow as the lives of their users change. Eventually, - when, for whatever reason, people no longer find them useful - they die. The artistry of the designers of buildings is exercised in the context of that life (Patricia Waddy, Seventeenth Century Roman Palaces (Cambridge: MIT, 1990) p. xi)*

This means the functional quality over time and their users are inextricably bound together through change in time: the rate of change of the building follows directly the rate of change of its users. The unit of analysis therefore transcends the building as a system to include its use in time.

In order to translate and relate the requirements of users to design attributes a *Systems Approach* is advocated. In a *Systems Approach* to built environment research, the physical features of the building and the actions of users are interactive and mutually interdependent, but can be observed and described as separate and interdependent variables (Marans and Spreckelmeyer, 1981; Vischer, 1985). It emphasizes interrelationships rather than a cause-effect relationship between environment and people and hence rules out architectural determinism (Preiser, 1983). This means the design attributes (system properties) of the building and the functional requirements of users can be identified and studied as separate but interrelated units of analysis. Using a *Hamburger Model*, Gielingh (1988) relates user demands variables (requirements) in terms of 'what' and 'why' (functional concept) to supply indicators (technical specifications) in term of 'how' (solution concept).

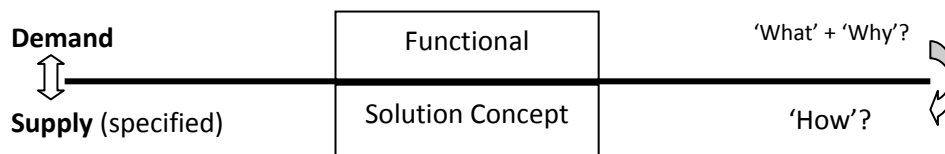


Fig. 4: Hamburger Model, (Gielingh, 1988)

These frames of thinking are overall consistent with the Performance-Based Building concept, which argues that a building system's design agenda as a whole, and the more specific design objectives of its parts, originates from relevant user requirements to be established by stakeholders such as users, owner/client, regulatory framework, design team, and manufacturers) (Prior and Szigeti, 2003a, 2003b; Foliente and Becker, 2005). From a product development point of view, Gijsbers *et al.*, (2009) observe that user requirements emerge from user values, which crystallizes into product functional requirements. To specify product characteristics these functional

requirements must be translated into design parameters which can then be represented using measurable engineering metrics (Fig.4).

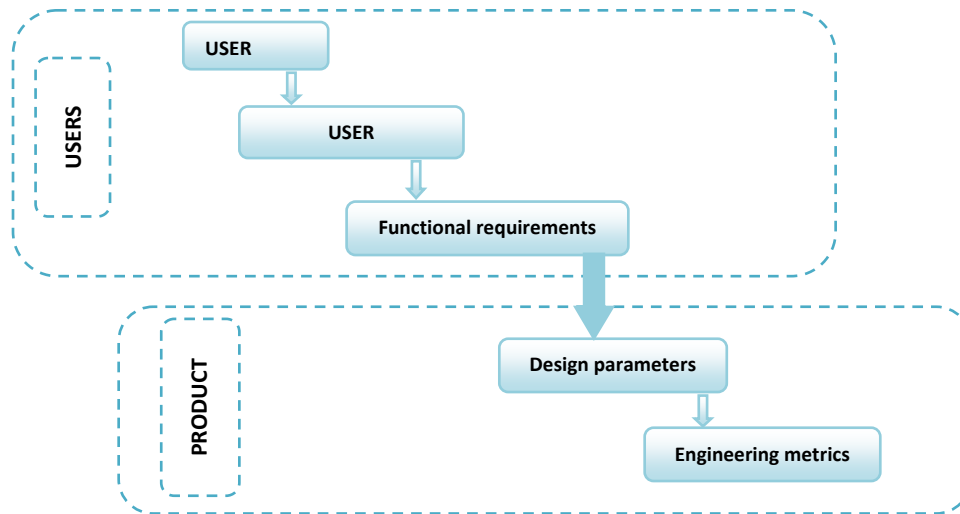


Fig. 5: The hierarchy from user values to product features (Gijsbers et al., (2009)

Put together, an overall research conceptual framework based on Systems Engineering (US Federal Government, 2001) may be represented as below. The model argues that to improve functional quality by design a continuous loop of synthesis between user functional requirements and building system properties is imperative.

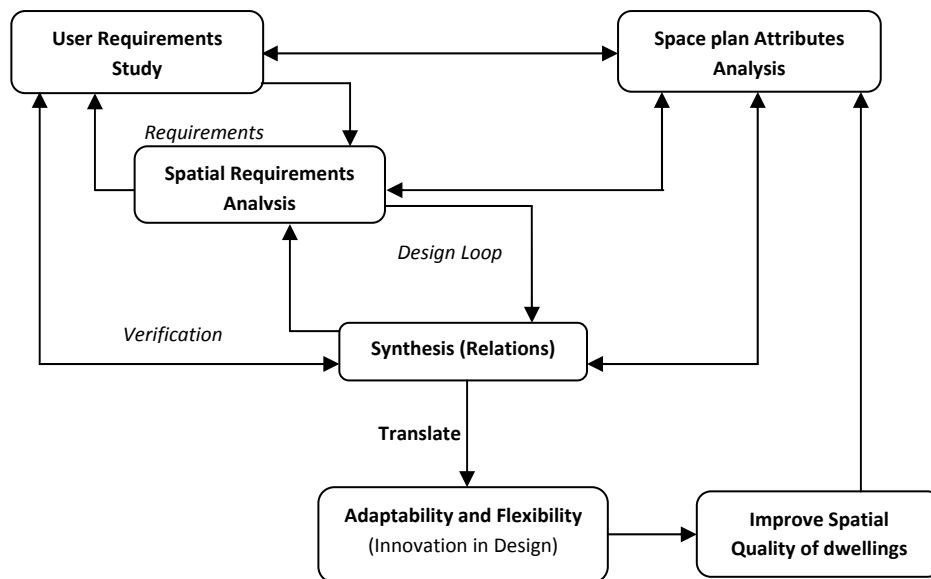


Fig.6: A model conceptual framework for research based on systems engineering approach

## RESEARCH DESIGN

From a time perspective, an ex-ante cross-sectional study design is considered appropriate for such a research. It is ex-ante because it seeks to model future solutions (BS2) based on an understanding of past trends (Kohler and Haasler, 2002). This is based on the Longevity Argument, which observes that evidence for the future is embedded in knowledge of the past through the present; the entire cause of the future

can therefore be assumed to be contained in the present (Pisaturo, 2009). The study is considered cross-sectional because it takes place at a point in time,  $t_2$  (Saunders et al., 1997). The proposition is that at the beginning of the life of the building, time  $t_1$ , functional quality analysis relating to spatial requirements based on the default philosophy 'form follows function' (Sullivan, 1924) results in the specification and supply of a dwelling with design attributes, BS1. This yields a level of spatial quality (SQ1) and is associated with a performance, P1. However, over time 'function melts form' (Brand, 1994) and by time  $t_2$ , a new level of functional quality (SQ2) is desired. For example, requirements for floor area of rooms in Dutch houses have shown an upward trend since 1965 (Hassler, 2009). Deilmann et al. (2009), reports that living space per dwelling in Germany since 1995, has increased from 29m<sup>2</sup> to 73.3m<sup>2</sup> in the East and from 21m<sup>2</sup> to 87.6m<sup>2</sup> in the West. It is however unknown what pattern of changes have occurred in user requirements over the past three decades and what trend these will follow in the years ahead. Understanding the current level of spatial quality required (SQ2) based on knowledge of the past (SQ1) is necessary on one hand for re-engineering the existing systems (BS1). Even more significantly, it can inform guidelines for innovations in future designs (BS2).

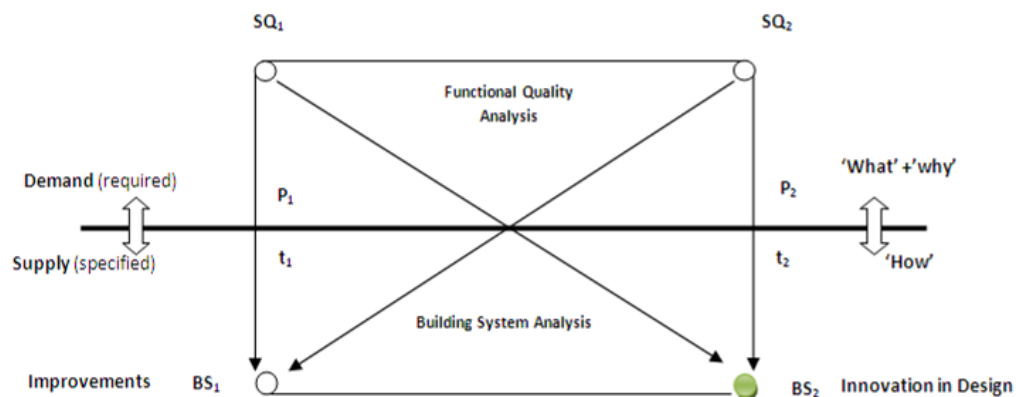


Fig. 7: Design of a lifespan-based building performance research

## CONCLUSIONS

Given the dynamic nature of modern society and technology, with its associated rapid transformation of the lifestyles of house residents, the shift in the function of dwellings from traditional shelters to serving multiple uses in time will potentially increase. Dwellings will therefore be as functional in terms of spatial requirements as they integrate the attributes of adaptability and flexibility. To the extent that this depends on understanding and integrating user requirements into design, relevant scientific knowledge on innovative techniques and methodologies is important. This paper has underscored the need for such a research, arguing for the extension of methodologies which focus on user satisfaction levels to include techniques which examine the prioritization of housing attributes and the ways users interact with their dwelling environments. In doing so it is possible to design dwellings which support the growing transitions of user requirements.

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# AN ARTIFICIAL NEURAL NETWORK MODEL FOR PREDICTING CONSTRUCTION COSTS OF INSTITUTIONAL BUILDING PROJECTS IN NIGERIA

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The deficiencies of the traditional estimating practice to cope with time pressure, accuracy and uncertainties have long been recognised. Therefore, it is imperative to seek for alternative methods which give reliable, accurate and quick estimate. This paper describes the development of Artificial Neural Network (ANN) model for cost estimation of institutional building projects in Nigeria based on 510 sets of detail project data. Nine predictor variables were identified in a pilot study for the model development. Both forward and backward stepwise regression analyses predicting LnCost, LnCost/m<sup>2</sup> and Cost/m<sup>2</sup> were employed for identifying key variables of the data. Four variables (Building Height, Construction Duration, Gross external Floor area and Proportion of Opening in External Walls) appeared in all the six search models, suggesting that they are the key predictors of the data. Three Semi-log regression models including different input variables were developed. Several Multi-layer back propagation networks were also developed from which the best model was chosen. The best ANN model was found to consist of 12 hidden units with a learning rate of 0.4. The result revealed that the ANN model outperformed the other models with an average % Error of -2.52% and MAPE of 5.4% which is an excellent performance.

Keywords: artificial neural network, multi layer perceptron, construction cost

## GENERAL BACKGROUND

Historically, building projects are regarded as successful if they are delivered at the right time, at an appropriate price (cost) and to quality standard desired by the client (Chua *et al* 1999; Ogunsemi 2006; Yaman 2007). Anigbogu *et al.* (2007) contended that the first step toward ensuring that problems are avoided in construction process is the production of accurate cost estimates. Kim *et al.*, (2008a) and Kim *et al.*, (2008b) asserted that the quality of early estimates is crucial to the feasibility analysis and budget allocation decision for public projects. The consequence of bad estimate at the early stage of a construction project according to Ashworth (1988), Ibrahim (2003) and Lowe *et al.*, (2006) includes embarking on an infeasible project and rejecting hitherto feasible project. Even though estimates are accepted as approximations that includes some degree of uncertainty, an early cost estimate that is too high may discourage the prospective client from proceeding further with the scheme (cost opportunities) or at least cause him to re-consider the scope of the project. Conversely, if the estimate is too low, it may result in abortive (wasted) development efforts; dissatisfaction on the part of the client such as (obtaining lower than expected returns).

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Ashworth and Skitmore (1983) stressed that a vital consideration with any method of estimating is the accuracy by which anticipated cost can be predicted. It has been suggested by Ogunsemi (2006) that a difference of 10% between tender sum and final account is considered an excellent performance. Unfortunately this contention cannot be said to be realistic going by the various studies carried out so far on the subject matter especially in the developing countries.

Regression analysis, simulation and neural network are some modern techniques used for the estimation of construction cost (Bhoka and Ogunlana 1999; Sonmez 2004; Sodikov 2005; Lowe *et al.*, 2006; Marzok *et al.* 2008), and the choice of any of these techniques is determined by its ease of operation, familiarity, speed and satisfactory degree of accuracy in conjunction with the availability of design information.

Emsley *et al.* (2002) worked with regression analysis and artificial neural networks to compare the two methods based on a data pool of 288 properties including residential Buildings. Up to 41 independent variables including site related variables (e.g topography), project strategic drivers (e.g type of contract) were included in the models, and in the best case, the model revealed a Mean Absolute Percent Error (MAPE) of 17% which is the mean difference between predicted values and observed values. Lowe *et al.* (2006) utilized 19 independent variables in their study using regression analysis to determine optimum model for cost prediction using different cost transformation. All of their models performed similarly with the best model having MAPE of 19.3%. Sonmez (2008) used a combination of regression and bootstrap techniques to integrate parametric and probabilistic estimation of building cost. The MAPE of the model was calculated as 12% indicating that the model can only estimate detailed cost with an average error of  $\pm 12\%$ . Cheng *et al.*, (2009) presented a new method combining three different computing methods namely, genetic algorithms (GA), fuzzy logic theory and neural networks under a mechanism called Evolutionary Fuzzy Hybrid Neural Network (EFHNN). The proposed mechanism is developed for design phase cost estimation of projects in Taiwan. They achieved an overall estimate error of 10.36%.

The disadvantage of the hybrid model (EFHNN) is that it has a very high computing time, due in large part to its use of GA.

The traditional estimating methods as opined by Cheng and Wu (2005), Lowe, *et al.*, (2006), Marzok *et al.*, (2008), have failed to cope with the problems of uncertainties and accuracy. In the light of this, Lowe *et al.*, (2006) and Cheng *et al.*, (2009) opined that it is essential to have more efficient estimating methods that will replace the current approaches which will address the need of speed, accuracy and uncertainty. As such, this study investigates the alternative through the use of Artificial Neural Network (ANN) that is seen to be a great potential in supporting the estimating process.

It has been established that ANN could be an appropriate tool to help solve problems which comes from a number of uncertainties, because of the fact that the back propagation neural network has a good nonlinear approach ability and high prediction accuracy (Pearce, 1997, Adeli *et al.*, 1998, Bokha and Ogunlana, 1999, Emsley *et al.*, 2002, Sonmez, 2004, Sodikov, 2005 Bouabaz and Hamami 2008 and Rao *et al.*, 2009). An ANN is an information processing paradigm that is inspired by the way the biological nervous system such as the brain process information. The key element of this paradigm is the novel structure of the information system. It is composed of a large number of highly interconnected processing elements called neurons working in

unison to solve specific problems. ANN like people, learn by example; An ANN is configured for a specific application such as pattern

recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well (Stergiou and Signanus, 2007).

## SCOPE OF WORK

The data for training and development of models were obtained from the records of institutional building projects initiated and completed between 1999 and 2008, contracted under the provisions of the Federal Ministry of Works forms of contract. For homogeneity of data collection the study is directed at a specific type of construction which is an important factor in modelling.

## RESEARCH METHOD

To achieve the study objectives, first a pilot study was carried out to establish the input variables used for the modelling. The data for the research was obtained through the use of structured questionnaires, expert interview and data of completed projects from the records of clients, consultants and contractors. Stepwise (forward and backward) regression analyses were used to determine significant predictor variables (cost drivers) of the data for the development of the models. Semi-log regression analysis and Back Propagation Neural Networks were used to develop cost predicting models. The Statistical Package for Social Science (SPSS) software is used for developing the regression models while NeuroSolution for Excel was used for developing the ANN models. The regression models and the best performing neural network model were compared in terms of their prediction performance. The two error measures that were used for the comparison are the mean squared error (MSE) and the mean absolute percent error (MAPE), they are calculated as follows:

$$MSE = \frac{1}{n} \sum_{i=1}^n (actual_i - predicted_i)^2$$

$$MAPE = \frac{1}{n} \sum_{i=1}^n \left| \frac{actual_i - predicted_i}{predicted_i} \right| \times 100$$

## RESULTS AND DISCUSSION

### Predictor variables

Sixteen relevant cost predictor variables were extracted from literature which could be used in developing cost predictive models using quantitative methods. The variables were reduced to eight in an expert interview with professionals confirming those that can be used based on the working conditions of quantitative methods (Makridakis *et al*, 1998). The identified input variables are shown in Table 1.

### Significant predictor variables

In order to determine key predictors of the data, simple forward and back elimination regression were performed. In the forward regression, a variable that correlates well with a number of cost significant variables may be included ahead of those variables. When other variables are considered for addition in the model, some of the information contained in them will already be present in the model, which will make

them appear less significant than they really are. One possible way of circumventing this problem is to perform a backward modelling technique. In the back elimination method, all the independent variables were considered in the initial regression model and variables that are not contributing to the model were eliminated one at a time. Three models were generated for each method, predicting LnCost, LnCost/m<sup>2</sup> and Cost/m<sup>2</sup>. These transformed cost variables were used because raw cost data was rejected as a suitable predictor for regression (Lowe *et al.*, 2006). From the result, the number of variables in the models varied considerably. The smallest number of variables used was 4 in the forward LnCost. The largest was 7 in the LnCost/m<sup>2</sup> backward. The backward technique yielded models with more variables than the forward selection technique. The LnCost backward, LnCost/m<sup>2</sup> forward and Cost/m<sup>2</sup> forward had 5 variables while the LnCost/m<sup>2</sup> backward had 7. That means by using backward selection it is possible to extract more significant variables than using forward selection.

Table 1. Input variables used for modelling

S/No	Variable	Unit	Minimum Value	Maximum Value
1	Building Height (X1)	M	3.2	13.2
2	*Compactness of Building (X2)	-	0.49	1.474
3	Construction Duration (X3)	Month	1.2	40
4	External Wall Area (X4)	M2	62.72	4280.3
5	Gross External floor area (X5)	M2	42.23	2416.36
6	Number of Floors (X6)	No	1	3
7	**Proportion of Opening on External walls (X7)	%	2.70	48.49
8	Location Factor (X8)	-	1.082	1.096
9	Time Index (X9)	%	6.00	18.90

\* Compactness of building is defined here as the external wall area divided by the gross external floor area.

\*\* Proportion of opening on external walls here refers to the area of external doors and windows divided by external wall area  $\times 100\%$ .

Out of the nine variables, five variables that appeared in five of the search models are; Building Height, Construction duration, External wall area, Gross external floor area and Proportion of Opening in external wall area. Four variables that appeared in all the six models are; the Building height, Gross floor area, Proportion of Opening in external wall area and construction duration. This suggests that they are the key predictor variables in the data. Therefore, these set of five variables, four variables and all the nine identified variables were used in forming regression models.

### Development of Regression Models

Three regression models were formed using the four variables that appeared in all the six test models, five variables that appeared five of the test models and all the nine input variables. The summary of the Regression models is presented in Table 2

Table 2 Summary of regression models

Model	Independent Variable	R	R <sup>2</sup>	Adj R <sup>2</sup>	MSE	SSE	F <sub>stat.</sub>	Sig.
RM1	$x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9$	0.951	0.904	0.886	0.018	0.750	48.492	0.000
RM2	$x_1, x_3, x_4, x_5$ and $x_7$ .	0.943	0.888	0.878	0.019	0.876	89.512	0.000
RM3	$x_1, x_3, x_5, x_7$ .	0.942	0.887	0.879	0.019	0.890	119.907	0.000

In table 2, RM1, RM2 and RM3 are the three transformed regression models. R refers to the correlation coefficient; R<sup>2</sup> refers to the degree of determination. Column 5 gives the adjusted R<sup>2</sup> while column 6 gives the Mean Square Error of the different models. Column 7 shows the F-statistics and column 8 gives the significance of the models.

### Regression Equation of Model 1 (RM1)

The equation of the best regression model (RM1) incorporating all the nine input variables is presented in equation 1

$$Ln y = 4.829 + 0.035x_1 - 0.56x_2 + 0.029x_3 + 0.167x_4 - 0.072x_5 + 0.063x_6 + 0.076x_7 - 1.996x_8 + 0.02x_9$$

### Regression Models and Errors

The Error measures for comparison and subsequent selection of the best regression model is presented in Table 3

Table 3 Errors of the regression models

S/N	Model	Maximum Error (% of Predicted total cost)	Average Error (% of Predicted total cost)	MSE	MAPE (%)
1	RM1	17.0%	-3.2%	0.123	10.38
2	RM2	27%	10.0%	0.174	12.57
3	RM3	28%	-3.5%	0.184	10.76

### Selection of Regression Model

From the three regression models incorporating different input variables, the first regression model including all the nine predictor variables outperformed the other two with Mean Square Error (MSE) of 0.123, MAPE of 10.38%, Maximum % Error of 17.0% and average % Error of -3.2%.

## DEVELOPMENT OF ARTIFICIAL NEURAL NETWORK

Several back propagation multi layer perceptron networks were developed using the nine input variables. Back propagation networks are multilayer forward networks using extended gradient descent based delta learning rule commonly known as back propagation (of errors) rule. Back propagation provides a computationally efficient method for changing the weights in a feed forward networks with differential activation function units to learn a training set of input-output examples. Being a

gradient descent method, it minimises the total squared error of the output computed by the network (Sivanandam *et al.*, 2005). The aim of this is to train the network to achieve a balance between the ability to respond correctly to the input patterns that are used for training and the ability to provide good responses to the input that are similar. One of the first tasks in developing an ANN model is to determine an acceptable threshold for error in output. An ANN model can be manipulated in many ways to improve its performance, including varying its internal architecture, learning parameters, or modifying the data set used to “train” it (Sivanandam *et al.* 2005). Given the large number of possible network configurations, selecting an acceptable level of error is important for the process of network experimentation. To select a threshold of acceptable error for the cost estimation problem, a range of acceptability of  $\pm 10$  (Ogusemi 2006) is used. Thus, an ANN model which could predict direct project costs within  $\{+10\%, -10\%\}$  was considered acceptable for the purposes of this research. The average, maximum and mean Absolute Percent Errors of the different network architectures are presented in Table 4.

Table 4 Network architecture and errors

S/No	Architecture (Input- Hidden-output)	Maximum % Error	Average % Error	MAPE (%)	MSE
1	9-1-1	10.8%	7.6%	16.32	0.2719
2	9-2-1	-22.52	-11.76	16.50	0.2129
3	9-3-1	11.2	5.91	14.83	0.2316
4	9-4-1	2.14	-1.39	11.20	0.2903
5	9-5-1	12.3	7.3	16.74	0.2721
6	9-6-1	14.0	6.10	6.5	0.0911
7	9-7-1	12.22	4.8	9.8	0.1367
8	9-8-1	12.72	-5.31	12.12	0.1842
9	9-9-1	8.61	-4.10	7.00	0.0531
10	9-1-1-1	23.15	12.02	10.7	0.1271
11	9-2-1-1	11.61	8.7	14.7	0.2339
12	9-2-2-1	12.70	-3.74	12.10	0.1782
13	9-3-2-1	13.2	8.34	15.2	0.3373
14	9-3-6-1	8.32	4.91	9.83	0.1862
15	9-6-3-1	10.3	-4.70	7.82	0.4447
16	9-3-5-1	12.42	6.21	11.7	0.2573
17	9-4-5-1	18.2	-3.19	8.14	0.1220
18	9-5-4-1	13.12	8.67	8.67	0.2459
19	9-5-5-1	9.2	4.3	12.2	0.2017
<b>20</b>	<b>9-7-5-1</b>	<b>7.26</b>	<b>-2.52</b>	<b>5.41</b>	<b>0.1273</b>

In Table 4, column 1 presents the serial numbers, column two gives the different network architectures which is the configuration showing input, hidden and output units of the networks. Column three gives the maximum errors, column 4 presents the average errors, column 5 gives the Mean absolute percent Errors and column 6 gives the Mean square Errors.

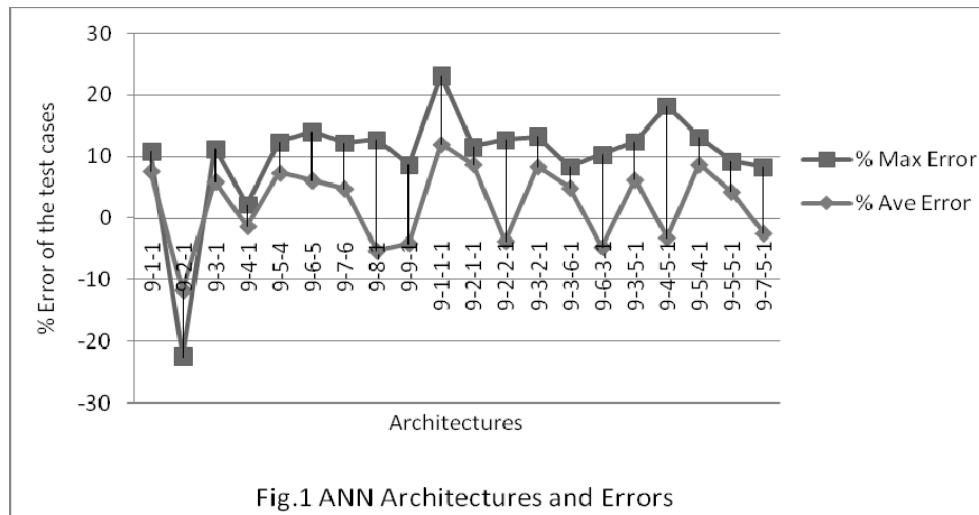


Fig.1 ANN Architectures and Errors

### Selection of ANN Model

Networks were trained for 50,000 epochs, and used a learning coefficient of 0.4 (Sodikov 2005) with a sigmoid transfer function. A larger value of learning rate has been found to lead to oscillations in weight changes which results in an increase in error. The best performing network has architecture of 9 input units, two hidden layers with 7 and 5 processing elements in the first and second layers respectively and 1 output unit. This network had an average error of  $-2.52\%$  and a maximum error of  $7.26\%$  in predicting project costs over the test set.

### Comparison of Models

The regression models and the ANN model were compared for closeness of fit and prediction performance based on the errors of the predicted values by the models.

#### I. Closeness of fit

The regression models and the best ANN model were compared based on the MSE and the MAPE. The result of the comparison (table 5) indicates that the ANN model provided better fit to the data.

Table 5 Comparison of models for closeness of fit

S/No	Model	Average % Error	Maximum % Error	MSE	MAPE
1	RM1	-3.20%	17.00%	0.138	10.38%
2	RM2	10.01%	37.01%	0.174	12.57%
3	RM3	-3.50%	28.10%	0.184	10.76%
4	ANN	-2.52%	7.26%	0.127	5.40%

#### II. Prediction Performance using cross validation technique

The prediction performance of the models is also compared using the same error measures (MSE and MAPE) but using cross validation technique. Fifty projects were selected randomly as the test sample and a new data set was formed. The training set included data from the remaining 460 projects but not data from the projects selected as the test sample. Model parameter for the regression and neural network models were determined with the training set model. The regression and the neural network models with the new parameters were then used to predict costs of the projects which were selected as the test sample. All of the projects are then selected as test samples in

groups of 50 and the procedure repeated for all the projects. Mean squared error (MSE) and Mean absolute percent error (MAPE) are calculated for the regression and neural network models. The MSE (0.078) and the MAPE (5.52) of the ANN from (Table 6) indicates that the ANN model had reasonably a good prediction performance. Therefore ANN model could be considered adequate for both closeness of fit and prediction performance.

Table 6 Error measures of models for prediction performance

S/No	Model	Average % Error	Maximum % Error	MSE	MAPE
1	RM1	-2.87%	23.35%	0.085	7.94%
2	RM2	-2.17%	24.82%	0.083	7.95%
3	RM3	-2.37%	24.03%	0.082	7.89%
4	ANN	-1.14%	22.3%	0.078	5.52%

### III. Prediction Accuracy

The calculated output of the test samples revealed that 46% of the test samples were underestimated while 54% were overestimated. The range of underestimating varies from -13.8% to -0.58% with an average value of -6.5%. The range of overestimating varies from 0.23% to 8.26% with an average value of 3.4%. These ranges shows that the model is not skewed to either overestimating or underestimating of the test samples. On the overall, the ANN model has an average percent error of -2.5%, a maximum % error of 7.26% and a MAPE of 5.4%. The value of MAPE of 5.4% is an excellent performance; it is within the acceptable range of  $\pm 10\%$  by Ogunsemi (2006),  $\pm 25\%$  for early estimates by Schexnayder *et al.*, (2003) and not far from the range for class 1(detailed) estimate of  $\pm 5\%$  of the Project Management Institute (PMI) and the range for definitive estimate of  $\pm 5\%$  of the Association of Cost Engineers (ACostE).

## CONCLUSION

The research revealed that it is possible to apply the methodology and framework for the best utilization of historical cost records of completed projects aided by computer technology so that cost estimates can be prepared at high accuracy. The ANN model developed has yielded satisfactory results on the test sample with average error of -2.32% and MAPE of 5.4% with a training time of less than 5 minutes. The model incorporates both time and location indices for it to be used at different times and locations. It also shows advantage over regression and other conventional methods of cost estimation that use the knowledge of the experts. Due to the supervised training, the network embedded the knowledge learnt from training samples in forms of “adjusted weights and biases” at minimum errors. The system errors were minimized by means of the Delta rule. Based on the findings of the study, it can be concluded that the objectives of the research outlined earlier has been achieved and hence construction cost prediction of institutional buildings are significantly improved by the means of ANN which can be realized with speed and accuracy. It is also expected that neural networks will be used with increasing frequency as a substitute for the conventional methods of estimating because practitioners will find its application very necessary because of its performance.

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# AN ASSESSMENT OF CORE SKILL AND COMPETENCIES OF QUANTITY SURVEYORS IN NIGERIA

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Competency-based measures are increasingly gaining ground as the most viable option for providing evaluative criteria for professional performance. While the development of framework for competence assessment is crucial for demonstrating the best practice and profession capabilities, the identification of the required skills and competencies of quantity surveyors, as well as the techniques for their assessment remains a research issue. Formal measures of skill and competence require definition and classification of skill and competence, type and extent. However, general literature on quantity surveying skill and competence illustrates a multiplicity of perspectives. Various classifications and definition of skill and competence reveals that they are very much at variance. This research aims to determine the core skills requirement and competence level of quantity surveyors in Nigeria; and to also develop a conceptual framework for their assessment with a view to enhancing their performance level. Drawing on the review of existing competence standards, this paper contends that an appropriate methodology for developing a robust evaluative criteria is to base competence standards on training, recruiting, performance and professional development. The next stage of the study will use a questionnaire survey to elicit information from relevant stakeholders in Nigerian construction industry on the skills and competencies of quantity surveyors. A Delphi technique approach is proposed for developing a conceptual framework for assessing quantity surveyors' competencies. Specifically, an expert panel will be put together to solicit their expert knowledge on the research questions. The responses of the experts will be combined to arrive at appropriate conclusions and recommendations.

Keywords: quantity surveyor, skills, competency, conceptual framework, Nigeria.

## INTRODUCTION

Quantity surveyors add value primarily to the financial and contractual management of construction projects at the pre-construction, construction and post construction stages. They contribute to overall construction project performance by acquiring, developing and deploying appropriate competencies (Nkado and Meyer, 2001). Competence-based measures are increasingly gaining ground as one of the most critical elements for organizational competitiveness and improvement (Motowidlo, 2000; Abraham *et al.*, 2001; Scullen *et al.*, 2003). Within the construction management discipline, the identification and development of competency-based measure is currently held as the only viable option for providing evaluative criteria against which performance can be validated (Van Scotter, 2000 and Dainty *et al.*, 2004). To this extent, the importance of core skill and competency standardization for professionals in the construction industry cannot be overemphasized. The general literature on quantity surveying skill and competence illustrates a multiplicity of perspectives (Male, 1990; Meyer and Semark, 1996; RICS, 1998; Nkado and Meyer,

2001; Crafford and Smallwood, 2007; Babalola, 2009). A detailed review of the various classifications and definition of skill and competence reveals that they are very much at variance. There is duplication of categorization and overlapping of definitions. Consequently, skill and competence classification and adoption are difficult to compare precisely because of diverse definitions.

The development of framework for competence assessment is crucial as it will demonstrate the best practice and in turn contribute to the enhancement of the profession capabilities. From the review of the existing competence standards developed by international and national institutions such as, The Royal Institution of Chartered Surveyors (RICS), Pacific Association of Quantity Surveyors (PAQS) and Australian Institute of Quantity Surveyors (AAQS), it is contended that an appropriate methodology for developing a robust evaluative criteria is that competence standards should be based on training, recruiting, performance and professional development. Bock and Ruyak (2007) have spelled out training and development, recruitment/selection and performance management as the areas that a successful competence standard should address. Nonetheless, there is a lack of conceptual framework to arrive at these prescribed areas of competency-based assessment for quantity surveyors. Clearly, there is a need to develop a more rigorous competency-based framework that can be used to match and select quantity surveyors, to assess their performance and also to engender their continuous professional development. The essence of this paper, therefore, is to address the above issues and problems by establishing the core skills and competencies requirement as well as developing a conceptual framework for their assessment.

## **THE CONCEPT OF SKILL AND COMPETENCE**

Competence has been defined as the ability to perform the activities within an occupation to the standard expected for employment. The Project Management Institute (PMI) (2002) defined competency as “a cluster of related knowledge, attitudes, skills, and other personal characteristics that affects a major part of one’s job, correlates with performance on the job, can be measured against well accepted standards, can be improved via training and development and can be broken down into dimensions of competencies”. The major components of competence were identified by Holmes and Joyce (1963) as: abilities, attitudes, behaviour, knowledge, personality and skills. Chan and Chueng (1996) broadly classified professional competence as cognitive or normative. Cognitive competence relates to the possession and application of a body of knowledge that is relevant, acceptable and exclusive to a particular social concern. Normative competence on the other hand relates more to the trustworthiness and social assumptions of professionals. Basically this is guided by the professional ethics and conduct. According to Talukhaba (2006), the Continuing Professional Development policies have been developed in many countries to foster professional competency and sustainability among registered persons.

## **REVIEW OF PREVIOUS STUDIES ON QUANTITY SURVEYORS’ SKILL AND COMPETENCE**

Nkado and Meyer (2001) in their study carried out a survey of quantity surveyors’ professional practice in South Africa and provided a relative importance of skills and competencies required for quantity surveying services. The results from the study indicated that technically oriented competencies were rated of highest importance. The profession was rated as deploying below average proficiency levels in marketing, advanced financial management, leadership, and project management. As good as the

findings of this study would have been, the respondents were limited to quantity surveyors only. This can be argued as self disclosure. As such the perception of other stakeholders - clients and other built environment professionals - will be a good complement to their findings. In an attempt to fill this gap, Crafford and Smallwod (2007) based their study on quantity surveyors' competencies on client perception. This study is also faulted in that; client's perception only may not be the best in judging quantity surveyors' competencies.

Babalola (2009) examined the core competencies of quantity surveyors in cost management and administration of electrical engineering services. This study revealed the relevant competencies expected of quantity surveyors and categorized them in the area of strength, weakness, opportunity and threats. However, the findings are limited to electrical services, which is a relatively small aspect of the gamut of activities in quantity surveying practice. Therefore, this cannot be used a good yardstick for listing quantity surveyors' core competencies.

## FRAMEWORK FOR ASSESSING QUANTITY SURVEYORS' COMPETENCE LEVEL

In order for a quantity surveying service provider to be able to determine whether its skill and training process are adequate, agreed measures are required to enable it to compare its competence with the best practice or against its competitors. Using a competency framework is not only a strategic way to focus talent, but such a framework also can build a strong corporate culture. Bock and Ruyak (2007) proposed a model for constructing core competencies in relation to law firm (Figure 1). This is made of seven closely interrelated subsystems that interface and support one another. In this research, Bock and Ruyak model will be adopted and restructured in four aspects in relation to quantity surveying profession (Figure 2). The first, **education and training** is the core subsystem which describes how learning takes place, and is shared, at individual, group and organizational levels. This creates the awareness of systematic formalized approach to education and training, and this is regarded as the first hurdle to overcome. In order to create a comprehensive training curriculum, devising an understanding of the critical foundational skills and all that revolve round it is crucial. This is the first area to be addressed by the framework. The second subsystem is **recruiting**. Since the best is expected from any professional, a competency framework can be used to rate skills and competencies of prospective hires. This calls for redesigning and restructuring of existing interview and recruiting processes. The third area of the competency integration is **core skill**. This focuses on the core skill required of quantity surveyors and is considered to be very crucial in the creation of competencies and performance level. This is seen as a way to determine the specific guidance as to the skills a professional quantity surveyor must demonstrate in order to advance professionally. Another area is **professional development**. This is considered an important aspect as it relates to maintenance, improvement and broadening of knowledge and skills. It also concerns the development of personal qualities necessary for the execution of professional and technical duties throughout a practitioner's working life (RICS, 1993).

Drawing on the theoretical framework and following an extensive reflection on the tenets of the theory adopted and other relevant literature, the task competencies will be operationalized from these four potential variables proxies as competency expected of quantity surveyors. At the end of the research, toolkits arising from the conceptual framework will be generated in the various aspects integrated in the system. By

having a framework such as this, everyone involved knows ahead of time what expectations are, how they are weighted and how performance will be assessed (Hollmann and Elliott, 2006).

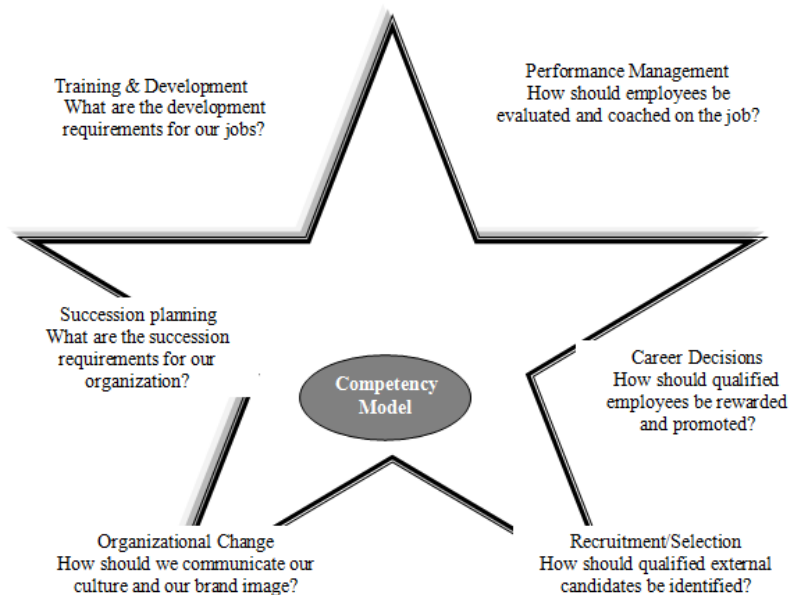


Fig. 1: Competencies linked to supporting systems (Source: Bock and Ruyak, 2007)

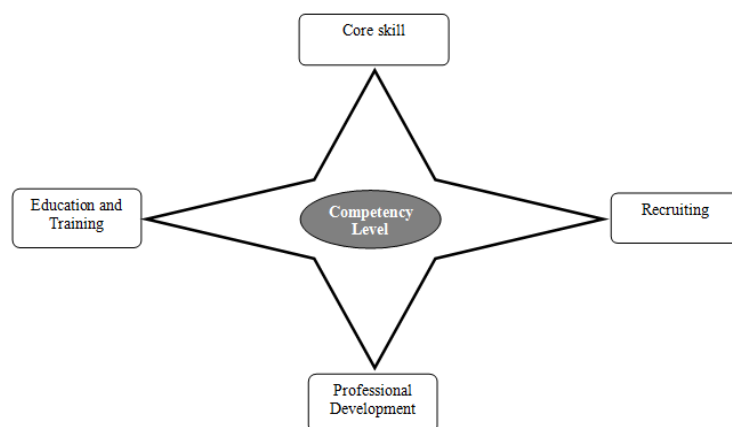


Fig. 2: Proposed conceptual framework for the study

## RESEARCH METHOD

The research approach adopted in the on-going Ph.D research described in this paper is the survey method. Questionnaire will be used in eliciting data needed for determining the skills and competencies required of quantity surveyors. In determining skill requirement and competencies of quantity surveyors, views and assessment from three sets of groups will be sought. The first set is the quantity surveyors themselves. The second group is the assessment from co- professionals. For

this group, the views of architects, engineers and builders who are found to have direct dealings with quantity surveyors, on construction projects, will be obtained. The last group is the client organizations who benefits mostly from the services of quantity surveyors. The database of these three groups will constitute the sample frame for the study. The population for the respective professionals will be obtained from the list published by their professional bodies and a systematic sampling method will be adopted. Out of the total population of the respected professionals, seventy percent (70%) will be selected as sample size. It is the researcher's belief that this size would adequately represent the entire population. Besides, authors such as Spiegel (1961) have submitted that if seventy percent of certain group falls within a particular class, then this class can represent the whole group. For the client organizations, there is no published list that can be employed. Thus, it is not possible to have an exact sample frame. Therefore, non-probability sampling incorporating snowball technique will be adopted in selecting client organization. Probable list of public and private client's organization will be generated from project consultants.

## **DELPHI TECHNIQUE**

The paper is also proposing a Delphi technique for the purpose of developing a conceptual framework for assessing quantity surveyors' competence level. Delphi technique is a statistical method used to get a consensus on a research subject. It involves survey of group of experts in a particular field and obtaining from them a consensus opinion by a series of intensive questionnaire interspersed with controlled opinion feedback. The technique is seen as a procedure to "obtain the most reliable consensus of opinion of a group of expert by a series of intensive questionnaires interspersed with controlled opinion feedback" (Dalkey and Helmer, 1963). This method allows input from a large number of participants than could feasibly be included in a group or committee meeting, and from members who geographically dispersed. It is intended for use in judgment in which pure model-based statistical methods are not practical or possible because of the lack of appropriate quantitative data, and thus where some form of human judgment input is necessary. There were four key features of Delphi study that separated it from any other statistical methods, namely participant anonymity, iteration over a number of rounds, researcher-mediated feedback and the statistical aggregation of group response. Anonymity is achieved through the use of questionnaires and this allow individual group member to express their opinion and judgments privately. With the iteration of the questionnaire over a number of rounds, the individuals are given the opportunity to change their opinions and judgments without fear of losing face in the eyes of the (anonymous) others in the group. Between each questionnaire iteration, controlled feedback is provided through which the group members are informed of the opinions of their anonymous colleagues. Feedback is often presented as a simple statistical summary of the group response, usually comprising a mean or median value (Brewer and Gajendran, 2009). Occasionally additional information may also be provided, such as arguments from individuals whose judgments fall outside certain pre-specified limits. At the end of the polling of participants (i.e. after several rounds of questionnaire iteration), the group judgment is taken as the statistical average of the panelists' estimates on the final outcome. For the purpose of constituting the panel, the database will include the Nigerian Institute of Quantity Surveyors (the professional body) and the institutions offering quantity surveying in Nigeria. The Nigerian Institute of Quantity surveyors is divided into state chapters and presently we are having 27 state chapters. The scope of the study will be limited to the south-western geopolitical zone of Nigeria. The choice

of this area is due to the fact that it has the largest population of both the registered practicing quantity surveying firms and individual registered quantity surveyors in Nigeria. Eighty (80) percent of the quantity surveyors in Nigeria are based in the selected study area. The chairmen of 6 chapters that comprises of the South-Western zone will be selected to be part of the panel. For the institution offering quantity surveying in Nigeria, we have 10 universities and 18 polytechnics. The Heads of Department of the 3 universities and the 7 polytechnics in the South-Western zone will be invited to be part of the panel. In addition the Chairman of the Education Committee and that of the Research and Professional Development Committee of the professional body will be included in the panel. Furthermore, 6 practitioners of the profession will be randomly selected and invited to make a total number of 25 experts that will be involved in the survey.

## CONCLUSION

This paper reviews skills and competencies of quantity surveyors and described a methodology for development of a conceptual framework for assessing quantity surveyors' competence level. While the development of framework for competence assessment is crucial for demonstrating the best practice and profession capabilities, the identification of the required skills and competencies of quantity surveyors, as well as the techniques for their assessment remains a research issue. Drawing on the review of existing competence standards, it is contended that an appropriate methodology for developing a robust evaluative criteria is that competence standards should be based on training, recruiting, performance and professional development. Against the backdrop, it is intended to use the proposed methodology to develop a conceptual framework for assessing quantity surveyors' competence level.

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# AN ASSESSMENT OF LIQUIDATED AND ASCERTAINED DAMAGES IN CONTRACT DELIVERY

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The study assessed the application of liquidated and ascertained damages (LAD) in contract delivery in Nigeria construction industry. Liquidated and ascertained damages has become a regular feature in construction contracts with the aim of providing a sense of security as to the recovery of damages from a contractor's failure to complete the work within the agreed specified time. Structured questionnaires were used to collect data from construction professionals and contractors. Forty two construction practitioners representing 70% of sample size responded. Descriptive and inferential analytical techniques were used to analyse data collected. The research revealed that fixed sum amount and 0.25 percent of contract sum per week were mostly adopted for the computation of LAD with cost of alternative facilities, loss of revenue from rent and additional supervision and administrative charges being very significant among factors considered in the computation. The major factors found to militate the implementation of LAD are fear of joint cause or concurrent delay, nature of the relationship between client and contractor and, incidence of non-compensable client caused delays.

Keywords: contract, liquidated and ascertained damages, Nigeria.

## INTRODUCTION

The performance indices of construction industry are indicator of the economic and social development of a country. According to Chan and Kumaraswamy (1997), completing projects on time is an indicator of an efficient construction industry, and also that a project completed on time, within budget, and to the specified quality standard is considered successful. Construction industry has widely been accepted to have relationship with the economic and social development of a country. This inter-relationship according to Mansfield, Ugwu and Doran, (1994) strengthens the need to ensure that project planning and project management are cost effective because improving construction efficiency by means of cost-effectiveness and timeliness in project delivery would certainly contribute to cost savings for the country as a whole (Kaming Olomolaiye, Holt and Harris, 1997). Projects are classically defined by the need to complete a task on time, to budget, and with appropriate technical performance/quality. In recent decades, projects have tended to become more time-constrained, and the ability to deliver a project quickly is becoming an increasingly important element in winning a bid (Williams, 2003). According to Al-Monami (2000) a vital section in the construction contract is the performance period or time of project execution, which is established prior to bidding. The fact that time, as an important factor to everyone in the construction industry, is of overriding importance to the client; the bearer of cost(s), is no news in need of popularity (Ogunlana and Promkuntong, 1996).

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A review of the literature has established that poor performance of projects in terms of time overruns over the decades is common place in the construction industry. A recent analysis by the World Bank shows that 53% of 291 contracts for goods, works and services completed between 1997-2002 suffered completion delays (World Bank, 2003). Odeyinka and Yusif (1997) have shown that seven out of ten projects surveyed in Nigeria suffered delays in their execution.

Though there is a wide range of views for the causes of time delays for engineering and construction projects. Some are attributable to a single party (contractor or client), others can be ascribed to several quarters (both parties) and many relate more to systemic faults or deficiencies (act of God) rather than to a group or groups, but this study seeks to look more in to the delay as result of default of the contractor which calls for the application of Liquidated and Ascertained damages' clause in every construction contract which primarily aimed at the contractor to deliver the project on time or else obliged to pay compensation to the client as liquidated damages (Tuuli, Baiden and Badu, 2007).

## **LIQUIDATED AND ASCERTAINED DAMAGES**

It is an established principle of law that where there is a right there is a remedy. Remedy therefore is the means by which the violation of a right is prevented, redressed or compensated. Remedies are of various types such as recession; injunction, specific performance, quantum meruit and damages. The above are the remedies the law awards to persons for injury he has sustained due to breach of contract.

In the construction industry, the remedy obtainable for delays on project delivery is Liquidated and Ascertained Damages (LAD). The aim of which is to place the injured party in so far as money can do, in the same situation as if the contract had been satisfactorily performed. (Okereke-Onyeri, 1992). Where there is a liquidated damages clause in a construction contract and the contractor has failed to complete the work on time, the employer can claim for the liquidated damages either by way of action or deduction or by a set-off.

Liquidated damage is then the sole remedy, stating an amount or rate calculated in advance, usually payable by the contractor, for a delay to a project or performance failure. It is usually expressed in the contract as a fixed sum or percentage of contract sum to be deducted daily or weekly for the period of delay. It is intended to be a genuine pre-estimate of what the damages are likely to be. Whilst provisions are made in the contract to vary the construction period for specific delays, if the project is still not finished by the revised completion date then liquidated damages as specified in the contract are payable to the client.

### **Contractual implications of liquidated damages**

West (2002) stated that the inclusion of liquidated damages in a contract has important implications in the overall system of construction cost control by providing an incentive for the contractor to complete the works within the contract period and so protects the client from additional costs generated by unauthorized time delays and, It enables the client to recover pre-estimated damages resulting from late completion of the works.

Turner (2009) also saw the contractual implications of the LAD as:

- Commercial tension is created for performance and/or timely delivery.

- The contracting parties have the certainty of knowing in advance what the financial cost of delay is and how that risk is allocated.
- The non-defaulting party benefits from making a recovery of damages without the difficulty and expense of proving actual loss (usually to the client's benefit)
- Legal costs are reduced with recovery of compensation made under the contract
- Contractual obligations are reinforced to deter breach.
- The contractor can appreciate the financial implications of completing, plan to complete on time or price the risk of delay.

Kwakye (1997) accentuates liquidated damages as being aimed at motivating the contractor to work diligently to meet the project's programme. It should be noted that the amount set for liquidated damages limits the extent of moneys the clients can obtain from the contractor regardless of actual costs. This affords protection to the contractor (under the contract) and allows tenders to price competitively in respect of such damages. Loulakis and Santiago, (1997) and Lynch, (2003) pointed out that, LAD clauses guarantee that a predetermined amount will be paid to the client in the event of inexcusable project delays for which the contractor is responsible. It therefore reduces cost that will be associated with litigating and proving damages, as the use of lawyers, witnesses and experts to recover losses through a long and costly process is avoided. LAD clauses also provide contractors at the tender stage with a measure of delay risks in the contract so that appropriate provisions can be made in the tender (Rumgay, 2003).

### **The perception of the courts on liquidated damages**

According to Seeley (1997) the precedent set by the courts for a valid assessment of damages was summarised based on the following conditions:

- The contractor must have failed to complete the works by the date of completion or within any extended time.
- The architect must certify in writing that in his opinion the works ought to have been completed.
- The contractor shall pay or "allow to the client" liquidated or ascertained damages.
- Only the "Sum calculated at the rate stated in the Appendix as liquidated and ascertained damages for the period of defaulting.
- Such deduction may be made from monies due under the contract.

The court or Arbitration as the case may be would have ascertained that the parties made a genuine attempt to pre-estimate the loss likely to be suffered for the sum stated to be considered liquidated damages and not a penalty, irrespective of actual loss. The Society of Chief Quantity Surveyors in Local Government; SCQSLG (1993), set up to investigate the procedures adopted for the assessment of LADs on local authority contracts in the UK, which saw them to concur with the view stated above by summarising the precedent set by the courts for a valid assessment of damages as follows

- If the parties make a genuine attempt to pre-estimate the loss likely to be suffered, the sum stated will be liquidated damages a not a penalty, irrespective of actual loss.
- The sum will be a penalty if the amount is extravagant having regard to the greatest possible loss that could be caused by the breach.

Different jurisdictions have therefore established standards as to what constitutes LADs and what does not and courts will generally enforce an LAD clause if the

amount bears a reasonable relation to the probable loss and the damages are difficult or impossible to determine (Wallace, 1995; Loulakis and McLaughlin, 2004).

Seeley (1997) also affirmed that liquidated damages clause will not be enforceable if it is considered to be an unreasonable estimate of the probable loss and therefore constitutes a 'penalty', a principle laid down by the courts in *Dunlop Pneumatic Tyre Co. Ltd v. Garage Co. Ltd* (1915). In this case, the court decided that a liquidated damages clause would be considered a penalty and unenforceable where the sum to be paid by the defendant was 'extravagant and unconscionable in amount in comparison with the greatest loss that could conceivably be proved to have followed from the breach'.

## **BASIS OF ASSESSMENT**

West (2002) explained that liquidated damages should be an estimate of the amount of total damages, including the effect of inflation that could be incurred by the Client in the event of late completion of the works. Care must be exercised in calculating both the contract time and the amount of liquidated damages, for tenderers may load their tender price in order to safeguard their interests if either is considered by tenderers to be unrealistic.

For many clients, early completion of a project can have profound effect on the return of their investments, and the delayed delivery of a project will cause loss of business opportunities and potential profits, or for public projects, create social/public problems (Shen, Drew, Zhang, 1999). However, LAD amounts specifies in construction contracts must also not be disproportionate so as to over compensate, profits, or unjustly enrich the injured party (Thomas, Smith, Cummings, 1995). High LAD amounts compared with the likely damages may also be considered a penalty and render the clause unenforceable while a low LAD amounts on the other hand, also do not fully compensate clients for delays. LAD amounts must therefore be reasonable and consistent with the costs than the owner is likely to incur in the event of late completion (Carty, 1995), and the courts will enforce LAD provisions when they are fair and reasonable estimates of anticipated losses and delays considered inexcusable.

According to West (2002), typical LAD amount factors needs to be determined according to the requirements of each particular contract and may be calculated on the basis of one or more of the following; Holding charges, Loss of revenue, Cost of alternative facilities, Additional supervision and administrative charges, All costs that might be incurred on other concurrent contracts because of delay.

Thomas et al, (1995) mentioned factors to be considered in assessing LAD and it seems to be in agreement with factors stated above by West (2002) which include; Loss of revenue or rental value, User costs, engineering and administrative costs, Additional wages, Moving costs, Interest and extended management and overhead fees.

In addition to the above factors, SCQSLG (1993) suggested that, lost of use of building, lost of business profit, lost of interest on the cost of the land and loss of interest on the cost of contract works should also be taken into account. In a survey conducted by Tuuli et al, (2007) loss of use of building/facility and loss of rent emerged as the most recurrent factors, often considered in LAD amount calculations. It is also interesting that, although the loss of interest on cost of works was considered the only factor capable of being genuinely pre-estimated to a degree of certainty by the SCQSLG (1993) report, it emerged the least recurrent factor considered in

calculating LAD amounts. The calculated LAD amount should then be expressed as a weekly or daily figure for the entire contract.

*Holding Charges:* This is the major factor to be taken into account and is an expression of the charges incurred by way of rates, taxes and interest on borrowed capital. The actual annual holding charges can be determined from individual consideration of factors and divided by 52 to arrive at a weekly rate.

*Loss of Revenue:* Should be taken into account where delay results in a loss of rent or other revenue to the client and where the loss and extent is readily established.

Examples of the types of projects where this could apply are residential developments and Commercial premises. For such projects, a flat rate equivalent to the expected rental income per week may be used regardless of the value of the contract. As rentals normally include a component to cover holding charges care must be taken to avoid duplication in establishing the figure for liquidated damages.

*Cost of Alternative Facilities:* Cost of alternative facilities to be used where the client incurs additional rental costs in existing accommodation pending completion of the project. This could also include, in the case of a school building project, the hire of temporary classrooms to meet additional student requirements.

*Additional Supervision And Administrative Charges:* Prolongation of the contract would give additional costs for the design teams supervision, resident professionals, clerk of works, supervisors and establishment charges such as telephones, power, sheds and so on. These too can be readily determined on a weekly basis. .

## **RESEARCH METHOD**

The literature review provided relevant information on the study. The Primary data was collected by means of questionnaire corroborated with interviews. The objectives to be achieved by the study guided the structuring of the questionnaire so as to solicit sufficient data from respondents. A range of 1- 5 value of Likert-type scale was utilised for questions on the degree of influence or significance of the subject matter. Data measured on nominal scale were analysed using descriptive statistics such as frequency distribution and percentages. Mean score were used to analyse data measured on ordinal scale. A total of sixty (60) questionnaires were distributed to cluster of professionals stratified from the total population into Architectural, Quantity Surveying, Construction firms and client's organisation involved in the role of contract administration while forty-two were received from the field survey. Out of 15 questionnaires administered to respondents in Architectural firm, 9 were received and 13 were received out of 15 administered to Quantity Surveying firm and 17 were also received out of 20 targeted at Construction firms. A total of 10 questionnaires were administered to professionals in the client's organization while only 3 responses were received.

## **RESULTS AND DISCUSSIONS**

Respondents level of professionalism were assessed for reliability. 54% of the respondents are graduate members of their professional institute, while 36% are Associate member of their respective professional institutes. Results on respondents' experience shows that, 45% of the respondents had 5-10 years of experience, 31% had 11-15 years of experience, 17% had above 21years and 7% had 16-20years of experience. This shows that the level of required experience needed to give genuine information on application of LAD was achieved. Results also shows that 36% of the

total respondents have been involved in about 1-5 projects in the last 5 years, while 26% have involved in 6-10 projects, 19% in 16 projects and above, 10% in 11-15 projects respectively, which indicates that the respondents are current well enough to the latest issues of delays and application of Liquidated and Ascertained damages in the industry while it was indicated that the 71% of the respondents have handled projects of contract sum of about 150million and above, and 14% of respondents have been involved in projects worth 100-150million with 1% and 5% for 50-100million and 10-50 million respectively. In this view, it is believed that respondents have been adequately exposed to large projects that required comprehensive contract administration. On delay on contract completion period 36% accepts 5-25% of projects have been completed at the specified contract period, while 21% accepts none of the projects have been completed at the specified contract time, though 19% of respondents believes all the projects handled by them have been delivered at the specified contract period, 12% accepts 25-50% and 50-75% are completed on time. This table helps in confirmation that respondents have been in one way or other experienced some aspects of delay in the project handled which could bring about the implementation or otherwise of Liquidated and ascertained damages.

### **Factors considered in computation of amount of LAD**

In responding to factors considered in calculating LAD amounts, the opinions of respondents were therefore unsurprisingly varied as shown in Table 1. Cost of alternative facilities ranked first among the factors considered in computation of LAD closely followed by loss of revenue from rent or others and Additional supervision and administrative charges. It is also interesting that, although Holding charges on cost of works was considered the only factor capable of being genuinely pre-estimated to a degree of certainty according to SCQSLG (1993) report, it emerged the fourth ranked. Except all cost incurred on other concurrent contracts which has the least mean of 2.33 representing less significant every other factors were ranked as significant in the study although none was ranked as very significant according to our scale of measurement. All the respondents indicated that they accept all the factors listed in the calculations of LAD amounts.

Table 1: Factors considered in computation of amount of LAD

Factors of consideration	Mean score	Mean
Cost of alternative facilities	3.43	1
Loss of revenue from rent or others	3.34	2
Additional supervision and administrative charges	3.33	3
Holding charges	3.26	4
Fluctuations in the cost of labour and materials	2.93	5
Additional wages incurred by the client	2.93	6
All cost incurred on other concurrent contracts	2.33	7

### **Methods of deduction of LAD**

It has been deduced from Table 2 that pre-estimate lump sum (per week) was ranked first, therefore it is mostly adopted for computation of Liquidated and Ascertained damages which can be obviously understandable because of the difficulty in calculation of the clients' pre-estimated loss at tender period. However, the variable nature of the contract sum in many projects renders this method unsuitable as variations can lead to an increase or decrease in the contract sum and hence the LAD



amount, which could then be an unrealistic reflection of any conceivable loss. According to Tuuli et al, (2007) expressing LADs as a percentage of contract sum was also relatively popular and having 3.24 mean score and ranked second in the table. This method is only partly acceptable if the amount of LAD was adequately assessed from first principles or the 'SCQSLG method' before expressing as a percentage of the contract sum. The pre-estimated lump sum/month and percentage of contract sum/month were ranked third and fourth respectively.

Table 2: Methods of deduction of LAD

Method	Mean	Rank
Pre-estimate lump sum (per week)	3.59	1
Percentage of contract sum (per week)	3.24	2
Pre-estimate lump sum (per month)	2.88	3
Percentage of contract sum (per month)	2.54	4

### Frequency of percentage of contract sum applied as LAD

Studying past projects' data it was observed that the amount or sums applied as LAD is in the range used in this research. As shown in the Table 3, it was revealed that 0.25%/week is ranked first as the most widely adopted percentage of contract sum based on the opinion of the respondents, 0.50%/week of contract sum is also very frequent by its status of being ranked second on the table, followed are 0.25%/ month and 0.50%/month which were ranked third and fourth on the mean score table. Other percentages adopted but not frequently used are 1.00%/month.

Table 3: Frequency of percentage of contract sum adopted.

Percentage	Mean	Rank
0.25% per week	3.60	1
0.50% per week	3.10	2
0.25% per month	2.80	3
0.50% per month	2.65	4
1.00% per week	2.39	5
1.00% per month	2.10	6

### Factors militating implementation of LAD

As shown in the Table 4, Fear of joint cause or concurrent delay is ranked first as factor militating the enforcement of Liquidated and ascertained damages with mean score of 3.45 which further supported by the findings of Table 4.10, where Untimely preparation and honouring of certificate by the client and Delay incurred in issuing drawings on variation which are all clients' caused delay to be the highest cause of delay on construction project. The fact that 'Nature of relationship between client and the contractor' is closely followed but ranked second in the Table 4 which agrees with findings of Tuuli et al. (2007) that the extended family system makes it possible to trace or prove some kind of relation between people, and this weakens the ability to be

firm in the enforcement of Liquidated and ascertained damages. Incidence of non-compensable client caused delays also closely ranked to the table but ranked as those significant factors hindering the enforcement of LAD. Sympathetic reasons from client and Corruption practices are also considered to be significant to this problem. In fact all factors are significant except two; the Ignorance of the client on provision of LAD in a contract and the Notion that payments only flows from client to contractor which is less significant.

Table 4: Factors militating implementation of LAD

Factors	Mean	Rank
Fear of joint cause or concurrent delay	3.45	1
Nature of relationship between client and the contractor	3.43	2
Incidence of non-compensable client caused delays	3.41	3
Sympathetic reasons from client	2.88	4
Corruption	2.81	5
Fear of punitive contractual claims	2.79	6
Unprofessional relationship between the consultants and	2.79	7
Political pressures	2.64	8
Fear of further delay from probable disputes	2.57	9
Omission of the provision for LAD in the contract	2.55	10
Ignorance of the client on provision of LAD in a contract	2.43	11
Notion that payments only flows from client to contractor	1.77	12

“Sympathetic clients” have often ignored or overlooked LADs when they are due. Fear of punitive contractual claims, Unprofessional relationship between the consultants and contractor and Political pressures are also significant in the problem faced in the enforcement of LAD.

## CONCLUSIONS

The study assessed the practice of liquidated and ascertained damages in contract delivery among construction professionals that have been involved in contract administration in Nigeria. Respondents considered all the listed factors in this study as significant in their computation of LAD with Cost of alternative facilities being significant closely followed by loss of revenue from rent or others and Additional supervision and administrative charges except costs incurred on other concurrent contracts which is less significant. The research revealed that pre estimated lump sum amount and 0.25 percent of contract sum per week were mostly adopted for the computation of LAD. The major factors found to militate against the implementation of LAD are fear of joint cause or concurrent delay, nature of the relationship between client and contractor and, incidence of non-compensable client caused delays. This would be better understood on many contracts having the liquidated and ascertained damages provision but was never applied perhaps due to ‘familial’ relationship among parties on the contract.

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# AN ASSESSMENT OF THE CAUSES OF FOUNDATION FAILURE IN THE RESIDENTIAL BUILDINGS OF JAMA'A STREET IN AREA B.Z AHMADU BELLO UNIVERSITY ZARIA-NIGERIA

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Many foundation failures are known to be attributed to inadequate protection to the foundation soils, lack of consideration in the engineering characteristics of the soils under different stress and loading conditions improper construction sequence and inadequacy of design against possible worst condition in the long term. This paper assesses the causes of the foundation failure in the area of study, evidently expressed through symptoms or signs (such as: cracks in dry wall, cracks in floors, cracked foundation, soil separation around the foundation etc.) , emanating from various sources of error and the soil condition. Investigation through the soil using the Atterberg liquid and plastic limit test revealed that the plastic index (PI) of the soil is all above 15% but below 20% indicating that the soil was a plastic soil and so was highly susceptible to settlement. In addition to the plastic nature of the soil, other factors such as; evaporation, subsoil drainage, sprouting tree roots, plumbing leakages, and also the possibility of accumulated constructional errors contributed to the foundation failures. Hence; Geotechnical and protective measures for preventing foundation failure are recommended.

Keywords: foundation failure, plastic limit, liquid limit, plastic index.

## INTRODUCTION

A building's foundation transmits loads from buildings and other structures to the earth. Geotechnical engineers design foundations based on the load characteristics of the structure and the properties of the soils and/or bedrock at the site. The primary considerations for foundation support are bearing capacity, settlement, and ground movement beneath the foundations. Bearing capacity is the ability of the site soils to support the loads imposed by buildings or structures. Settlement occurs under all foundations in all soil conditions, though lightly loaded structures or rock sites may experience negligible settlements. For heavier structures or softer sites, both overall settlement relative to unbuilt areas or neighbouring buildings, and differential settlement under a single structure, can be concerns. Of particular concern is settlement which occurs over time, as immediate settlement can usually be compensated for during construction. Ground movement beneath a structure's foundations can occur due to shrinkage or swell of expansive soils due to climactic changes, frost expansion of soil, melting of permafrost, slope instability, or other

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causes. All these factors must be considered during design of foundations (Mitchell et al, 2005).

Failure is an unacceptable difference between expected and observed performance. A failure can be considered as occurring in a component when that component can no longer be relied upon to fulfil its principal functions. Limited deflection in a floor which causes a certain amount of cracking/distortion in partitions could reasonably be considered as defect but not a failure, whereas excessive deflection resulting in serious damage to partitions, ceilings and floor finishes could be classed as a failure (Roddis, 1993). In Nigeria, building failures have been attributed to the following causes: design faults (50%), faults on construction site (40%) and product failure (10%) (Oyewande, 1992). Hall (1984) ascribed faulty design, faulty execution of work and use of faulty materials as major causes of structural failures. Frederick and James (1989) suggested that the overturning of structures due to heavy wind loads, sliding of structures due to high wind, roof uplift or sliding, and building sway due to lateral loads are major types of failures of buildings. On the other hand, Akinpelu (2002) categorized the following as major causes of structural failures: environmental changes; natural and man made hazards; improper presentation and interpretation in the design. Richard (2002) opined that deterioration of reinforced concrete could occur as a result of: corrosion of the reinforcement caused by carbonation and chloride ingress, cracking caused by overloading, subsidence or basic design faults, and construction defects.

Seeley (1993) recognized three major types of maintenance in building in order to restore its defective elements to an acceptable standard namely; day to day, cyclic, and planned maintenance. Those who investigate and report on failures of engineered facilities are in a good position to identify trends leading to structural safety problems and to suggest topics for critical research to militate against this trend (Chapman, 2000).

A building can be defined as a space envelope designed to provide a minimum level of comfort and convenience for the inhabitant. It is expected to shield the owner from hazards of weather, unreasonable level of sunlight and penetration. It must be properly planned, designed and erected to obtain desired satisfaction from the environment (Oyenuga, 2004).

The factors to be observed in building construction include durability, adequate stability to prevent its failure or discomfort to the users, resistance to weather, fire outbreak and other forms of accidents. The styles of building construction are constantly changing with introduction of new materials and techniques of construction. Consequently, the work involved in the design and construction stages of buildings are largely that of selecting materials, components and structures that will meet the expected building standards and aesthetics on economy basis (Ayininola and Olalusi, 2004).

Jama'a Street is made of two rows of residential buildings consisting of eighteen (18) self contained apartment blocks. It is located in area B.Z in Ahmadu Bello University, Zaria (Main Campus). The residential buildings in this street are made primarily of two design pattern; one being a 3-bedroom apartment and the other a 2-bedroom apartment. It is relatively on lowland compared with the relief of the entire school, as evidently expressed by the bountiful deposit of alluvial soil in the area particularly in the street under consideration being the last street in the area. Basically, from a visual analysis of the type of soil in the street, one may conclude that the type of soil present

is purely silt in nature, however because of the variable nature of soil even in a particular site, samples were collected at a depth of 1.2m (below the strip foundation) for the soil analysis.

## MATERIALS AND METHODS

The laboratory tests on soils was carried out in accordance and compliance with the specifications contained in BS 1377 'Method of Test for Soil for Civil Engineering Purpose' directed at investigating liquid limit and plastic limit of the soil samples with the view to finding the bearing capacity of the soil, in order to achieve this, soil samples were taken at 1.2m below the strip foundation. Also a survey involving visual inspections of few selected failed buildings in the study areas was carried out. Failure types observed were noted and presented with photographs taken from different views within the area.

### Liquid limit test

For the liquid limit test, soil samples were oven dried after which they were broken down using the mortar and the pestle. These broken samples were then sieved using the BS sieve through a 425micron meter sieve size until about 150g of the material was obtained. After obtaining the sieved samples, the soil samples were placed on a glass plate and added distilled water slowly, mixing the soil and the water up using two spatulas to ensure a thick and homogeneous mix. Having gotten the soil paste, some quantity of the paste were taken and placed in the cup of the liquid limit apparatus and leveled to form a nearly flat layer with a mix depth up to about 10mm; which was about the same level or slightly lower than the lowest point on the rim of the cup. The soil sample was then divided centrally with the grooving tool which is held along the cup. The groove was clearly cut at 2mm wide along the bed of the cup. The soil in the cup was then removed from the cup and added to the remaining of the sample for the re-mixing. At this point, the cup and the grooving tool were washed before repeating the procedure with successive addition of distilled water to the sample, hence obtaining results with the number of blows ranging from 15-30 to 40-60.

Table 1 Computation of the liquid limit on test samples

Attempt/Sample No	01	02	03	04	05	06	07	08	09
No Of Blows	35	38	32	40	37	34	32	37	36
Moisture Content (%)	41.81	39.56	40.40	39.58	41.30	41.80	42.10	39.60	40.70

### Plastic limit test

Samples of about 150g of soil in the same manner as for the liquid limit were prepared for the plastic limit test but ensured that it was mixed thoroughly with distilled water until it could be made into a homogeneous ball of plastic consistency. Having done that, some of the paste was rolled. The ball between the palm and the glass plates were rolled to form soil into thread. The diameter of the soil was gradually reduced up to 3mm and the soil was then kneaded together and rolled again. This process gradually reduces the moisture content at 3mm diameter. However, a 3mm diameter rod used in order to serve as a guide in determining the correct size. Also for the soils that crumbled at large diameter, it simply implies that wetting the soil was necessary. Having rolled the ball of the soil into 3mm diameter; the dry mass of the weighing tin was taken on the balance and the crumbled portion of the soil sample were collected and placed on the tin and weighed. It was then left in the oven to dry at a temperature

in the excess of 10<sup>0</sup>C for a period of about 24hrs. Finally the tin and the oven dried samples were weighed and their moisture content corresponding to their Plastic Limit. The same procedure was used for the five samples taken from different trial pits.

Table 2 Computation of the plastic index of the test samples

Sample/Attempt No	Liquid Limit (LL)	Plastic Limit (PL)	Plastic Index (Pi=LL-PL)
1	41.81	26.41	15.40
2	39.56	22.86	16.70
3	40.40	23.20	17.20
4	39.58	23.68	15.90
5	41.30	25.20	16.10
6	41.80	25.10	16.70
7	42.10	24.50	17.60
8	39.60	24.00	15.60
9	40.70	25.80	14.90

From the two tests conducted it is observed that plastic index (PI) is all above 15% but bellow 20%, and according (Minikin, 1946) and (John and Frank, 1961), the plastic limit for clay varies from **20-35%** and the liquid limit from **40-50%** and finally there plastic index ranges from **15-35%** and above for extremely plastic soil. Hence it can be seen that the result of test on the soil sample indicates that it is a plastic clay soil. Hence the ground surface condition is a clear indicator of a typical plastic soil. It is compressible and can cause settlement of the foundation. It seems to be slightly impermeable, hence there is usually water pounding around the foundation of the building.

### Foundation behaviour

The foundation was dug to a depth of 1.2 m (below the strip foundation), and the soil was a plastic clay soil. Also, visual observations of the topography of the premises where the buildings were located showed that they were built on a lowland area. There was an indication of a need to carry out geotechnical tests (the soil was found to be plastic in nature), and the failure was clearly associated with the foundation.

### Structural behaviour

Casual and close inspection of the outside of the buildings showed that the walls had cracked in many places in both lower and upper sections. There are wide horizontal and vertical cracks and several criss-cross cracks in the walls. The cracks are more pronounced in the eastern walls. Figure 1(a) and (b) shows a set of vertical and cracks in the recessed eastern part of the front wall. The cracks observed on the walls of the buildings to mention but a few are numerous with their sizes ranging from 6mm to about 24mm which is quite a large or severe case of cracking. Figure 2(a) and (b) shows a wide internal crack above the window level, Symptoms of foundation failure was also common to almost all the eighteen (18) building in this street evidently expressed by even cracks at the door and window posts as shown in fig3a and b. Cracks were also found at the base and in virtually all the buildings in this street even though it was more pronounced in some certain buildings than the others. For instance in the buildings with the street addresses 7, 4 and 11, cracks measured up to 28mm, a value which is quite large to be overlooked as evident in fig4a and b.





Fig 1a

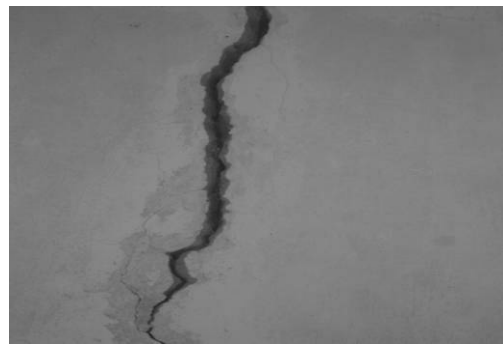


Fig 1b



Fig 2a

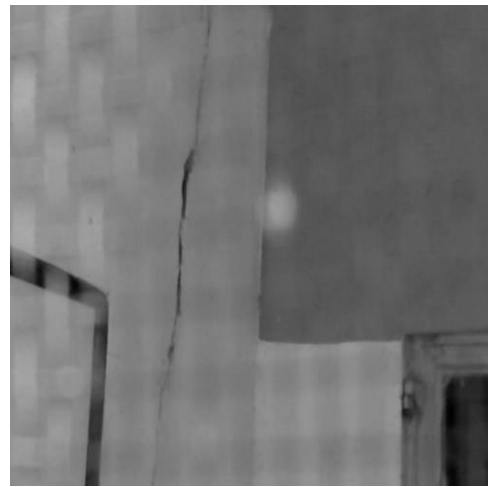


Fig 2b



Fig 3a



Fig 3b



Fig 4a



Fig 4b

## CONCLUSION AND RECOMMENDATION

On the basis of this study, the failures of the foundation in the area of study manifested in the form of serious cracks in the walls and floors and were attributed to effect of soil saturation and build-up of pore water pressure in the slope ground, resulting from plastic nature of the soil. Investigation also concluded that inadequacy of existing drainage system (i.e. Surface drains) is also a contributing factor. Thus it was observed that the mode of failure was likely attributed to the development of tension cracks and deep sliding plane through the underlying soft clay due to the inadequate shear strength. Hence, it is recommended that this possibility be further verified in subsequent studies through stability and bearing capacity analyses for factor of safety values. Adequate surface protection and drain system including surface and subsoil drains shall be provided to prevent surface erosion and soil disturbance, due to infiltration of rainfall. The slope should possess adequate factor of safety against possible slip failure in long term.

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# AN ASSESSMENT OF THE EFFECT OF COMMUNITY PARTICIPATION ON SUB-URBAN DEVELOPMENT IN AKURE, NIGERIA

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Participatory development is the most important approach towards enabling communities to help themselves and sustain efforts in development work. Communities are no longer seen as recipients of development programmes; rather, they have become critical stakeholders that have an important role to play in the management of programmes and projects in their areas. This study evaluates the effect of community participation towards the development of the sub-urban areas in Akure South Local Government Area, Ondo State, Nigeria. Data were collected with the aid of structured questionnaire administered to 200 community leaders/residents in 22 communities and 10 Staffs in the Ministry of Community Development and Co-operative Societies. A simple random sampling technique was employed in the selection and data analysis was by the use of descriptive statistics. Findings revealed that most projects carried out within the sub-urban area are usually of low standard when compared with that provided by the government; it was also discovered that for a project to be more effective, there must be joint participation of both the community members and the government. Based on the findings of the study it was recommended among others that in order to intensify participation in community development, re-education and re-orientation programmes should be organized by the government which will educate the citizenry on the necessity to participate fully in the development of their neighbourhood themselves through self-help activities since the government cannot satisfy the immediate needs of all the communities within its jurisdiction at a goal.

Keywords: community, community development, community participation, sub-urban development.

## INTRODUCTION

Community participatory development refers to the process of development that people living in a community participates voluntarily, having identified their problems, makes decision in choosing the methods to use, set goals and procedures on how to solve the problems. They also get involved in the problem solving process by evaluating the results of the community development projects and gaining benefits from such development project.

In most developing countries, increased level of income, social and educational awareness has created new standard of living, which has led to enhanced level of social standard of living. As these nations grew in size, the provision of houses has become more costly; there are new problems of health, safety and communications,

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which create the needs for sewer, drainage, water pipes, roads, etc. The pressure on community infrastructures has been accentuated by the parallel modernization of urban economics and the marginalization of rural economy. These have often led to the concentration of rural migrants into urban areas without facilities for survival (Masoni, 1985). In response to these pressures, sub-urban communities have sought relief by providing certain facilities/infrastructures for themselves through self-help programmes.

Declining satisfaction with the urban environment is held to blame for continuing migration to smaller towns and rural areas (so-called urban exodus). Successful urban planning and supported regional planning can bring benefits to a much larger hinterland or city region and help to reduce both congestion along transport routes and the wastage of energy implied by excessive commuting. Before the advent of modern civilization, most of our communities were closely knit together and they were all involved in one participatory activity or the other. The present day modern schools, hospitals, roads etc did not exist. In the olden days, many of the roads that reached the communities were bad and not motor able with dilapidated bridges. Through community efforts however, these roads were repaired and maintained.

The rapid growth of urban population in developing countries led to a corresponding increase in the demand for basic urban services. Community members generally participate in development projects because of the realization that contemporary governments can no longer single handedly meet most of these community needs.

Community participation as an approach requires commitment from the people and can eventually provide project effectiveness, efficiency and empowerment. Although sustainable community participation and management alone cannot guarantee success, it can also play a vital role in creating both an effective and efficient developments project. Janet Townsend (1993) aptly pointed out that “the participation of local people in a project can mean involvement in all design and implementation, or merely a show of consultation which is never intended to be allowed to change anything”.

According to the World Bank 1994, Participation can be regarded as a process through which the stakeholder’s influence and share control over development initiative and the decisions that affects them. Friedman (1992) buttress that community participation can be defined as everybody possessing of his/her own and nobody can interpret it better than that person hence the reason why development begins with the people who understand their livelihood better than any other person does. In community participation, its objective is seen as an active process that includes empowerment of individual in the community, building beneficiaries capacity, increase project effectiveness, efficiency and cost sharing and the level of participation therein are information sharing, consultation, decision making and initiating action (UNDP, 2000).

Oakley and Marsden (1987) defined community participation as the process by which individuals, families, or communities assume responsibility for their own welfare and develop a capacity to contribute to their own and the community’s development. In the context of development, community participation refers to an active process whereby beneficiaries influence the direction and execution of development projects rather than merely receive a share of project benefits (Paul, in Bamberger, 1986). Paul’s five objectives to which community participation might contribute are:

1. Sharing project costs: participants are asked to contribute money or labor (and occasionally goods) during the project’s implementation or operational stages.

2. Increasing project efficiency: beneficiary consultation during project planning or beneficiary involvement in the management of project implementation or operation.
3. Increasing project effectiveness: greater beneficiary involvement to help ensure that the project achieves its objectives and those benefits go to the intended groups.
4. Building beneficiary capacity: either through ensuring that participants are actively involved in project planning and implementation or through formal or informal training and consciousness- raising activities.
5. Increasing empowerment: defined as seeking to increase the control of the underprivileged sectors of society over the resources and decisions affecting their lives and their participation in the benefits produced by the society in which they live.

Bamberger (1986) opined that the objectives and organization of project- level activities are different from those of programs at the national or regional levels. The level or scope of the activity must be taken into consideration when defining objectives. According to him, there are three kinds of local participation which are:

1. Beneficiary involvement in the planning and implementation of externally initiated projects or community participation.
2. External help to strengthen or create local organizations, but without reference to a particular project, or local organizational development.
3. Spontaneous activities of local organizations that have not resulted from outside assistance or indigenous local participation.

The first two are externally promoted participatory approaches used by governments, donors, or NGOs, while the third is the kind of social organization that has evolved independently of (or despite) outside interventions (Bamberger, 1986). At a community level, there is the separation of community participation into two distinct approaches: (1) the community development movement and (2) community involvement through conscientization (Freire, 1985). The basis of conscientization, according to De Kadt, started from “the existence of socioeconomic inequalities, the generation of these by the economic system, and their underpinning by the state” (De Kadt, in Abbott, 1995).

Benn (1981) considers that “Participation has unfortunately become a cliché word, which makes many people squirm, long before it has developed any content. Everyone plays lip service to it, without having much idea as yet of what it means and how you achieve it, and often also without genuinely wanting it except to the extent they can use it to further their own ends”.

The term '*community participation*' refers to the involvement of the beneficiary community in the implementation and delivery of housing and other developmental goods. It should promote a 'partnership connecting horizontally amongst people of equal status, but not necessarily of equal power, and vertically between those who set policies and those who live within the framework of these policies' (Goethert and Hambdi, 1988, in Gounden, 1993).

Despite this contention on just what participation means and what benefits it produces, it has remained an increasingly popular endeavour of governments, interest groups and members of the public. In simple terms '*community participation*' refers to the involvement of the people in a community in development projects (UNCHS, 1991;

Sheng, 1992; Korten, 1987; Garilao, 1987). Since social, economic, educational, and other conditions differ from one community to another, the form and degree of people's involvement in development activities also vary. This makes it difficult to define community participation precisely.

However, since it implies action by the people to solve their own problems, it can be understood in terms of activities performed by the communities in their own development projects. There is a wide range of types of community participation. At one end of the scale there may be merely some community participation in an agency designed and executed project. At the other, it is full community planning, implementation and management of a project with no agency involvement (Friedman, 1992).

The word “development” is fraught with ideological, political, and historical connotations that can greatly change its meaning depending on the perspective being discussed (Haug, 1997). The following three definitions of development are most helpful and suitable in relation to this research project. The first definition is provided by Korten (1990):

Development is a process by which the members of a society increase their personal and institutional capacities to mobilise and manage resources to produce sustainable and justly distributed improvements in their quality of life consistent with their own aspirations. Korten's definition emphasizes the process of development and its primary focus on personal and institutional capacity. It also touches on justice, equity, quality of life, and participation.

The second definition is from Robinson, Hoare, and Levy's (1993) work. He adds the dimension of empowerment to Korten's idea of development (Robinson, 1993).

Empowerment can be described as a social action or process that promotes participation of people, organizations, and communities towards the goals of increased individual and community control, political efficacy, improved quality of life, and social justice.

Finally, Zachariah and Sooryamoorthy (1994) emphasize that development must promote economic growth, but not at any cost: The encouragement of economic growth must take account of and be restrained by three other equally important objectives:

1. Protection of the environment and consideration of the ecological impact of industrialisation and commercialisation.
2. Fair and equitable distribution as well as redistribution of goods and services to enable poorer people to get a fairer share of society's wealth and to participate fully in the economy.
3. Creation of opportunities for everyone to increasingly participate in the political, artistic and other activities of society.

Zachariah and Sooryamoorthy's criteria for development recognize the environmental and ecological facets of communities going through the process of development. The environment is considered an integral part of development, since any impacts on a person's environment also influence the state of well-being or welfare. Environment and development are thus linked so intricately that separate approaches to either environmental or developmental problems are piecemeal at best (Bartelmus, 1986).



To understand and be able to implement community participation in development planning, it is important to understand the levels of community participation in development planning. This is because some of the levels are more relevant than the others to ensure authentic community participation (Theron, 2005). There are different levels of participation in the planning process with differing intensities of community involvement, and these can be illustrated through what is known as the 'ladder of participation' (Pretty, 1995). The seven (7) levels of community participation as highlighted by Pretty, et al. (1995) in Theron, 2005 are:

*Passive participation:* People participate by being told what is going to happen or what has already happened. Participation here relates to a unilateral top-down announcement by the authority/project manager.

*Participation in information giving:* People participate by answering questions posed in questionnaires or telephone interviews or similar public participation strategies. The public do not have the opportunity to influence proceedings as the findings of the research are neither shared nor evaluated for accuracy.

*Participation by consultation:* Here, people participate by being consulted, as professionals/consultants/planners listen to their views. The professionals define both problems and solutions and may modify these in the light of the people's responses. This process does not include any share in decision-making by the public, neither are the professionals under any obligation to consider public's views.

*Participation for material incentives:* People participate by providing resources, that is, labour, in return for food and cash. This typology typically takes place in rural environments, as farmers provide the fields but are not involved in the experiment or learning process. The people have no stake in prolonging activities when the incentives end.

*Functional participation:* Here, people participate in a group context to meet predetermined objectives related to the project, which can involve the development or promotion of externally initiated social organizations. This type of involvement does not tend to occur at the early stages of project cycles or planning, but rather after important decisions have already been made.

*Interactive participation:* People participate in joint analysis, the development of action plans and capacity building. Participation is seen as a right, not just the means to achieve project goals.

*Self-mobilization:* People participate by taking initiatives independent of external institutions to change systems. This bottom-up approach allows people to develop contacts with external institutions for resources and the technical advice they need, but they themselves retain control over how the resources are used. Such self-reliant mobilization and collective actions may or may not challenge the existing inequitable distribution of wealth and power.

## RESEARCH METHOD

**The site of study:** research investigation took place at Akure – the administrative and political capital of Ondo State of Nigeria. The city is located within Ondo State in the South Western part of Nigeria. It lies within Latitudes 7°15'N and 7°28'N North of the Equator and Longitudes 5°6'E and 5°21'E East of the Greenwich Meridian. It is located approximately 700 kilometres South West of Abuja, the Federal Capital of Nigeria and about 350 kilometres to Lagos the former capital of Nigeria and it is

located within the tropical rain forest region of Nigeria where rainfall is high throughout the year. It became the capital city of Ondo State and a Local Government headquarters in 1976. The city's morphology has changed over time to assume its present status with its attendant land use problems, as experienced in similar medium sized urban centres in Nigeria. Akure has three kinds of residential settlement patterns – the core area, the peripheral neighbourhood core and the suburbs (Olotuah, 2000). The city has witnessed immense growth in size of built up areas, number of immigrants, transportation, and commercial activities and has attracted both major investors and private developers into the town. The total area is approximately 41.2km<sup>2</sup> and it lies on a relative plain of about 250m above the sea level.

The population of the city grew from 38,852 (Thirty two thousand, eight hundred and fifty two) in 1952 to 71,106 (Seventy one thousand, one hundred and six) in 1963. Its population was estimated to be 112,850 (One hundred and two thousand, eight hundred and fifty) in 1980 (DHV, 1985); 144,544 (One hundred and forty four thousand, five hundred and forty four) in 1987, 148,880 (One hundred and forty eight thousand, eight hundred and eighty) in 1988, 153,347 (One hundred and fifty three thousand, three hundred and forty seven) in 1989 and 157,947 (One hundred and fifty seven thousand, nine hundred and forty seven) in 1990 (Ondo State of Nigeria, 1990). The 1991 national population census however, put the population of Akure at 239,124 (Two hundred and thirty nine thousand, one hundred and twenty four) and its estimated population in 1996 was 269,207 (Two hundred and sixty nine thousand, two hundred and seven) (NPC, 1996). At present based on the last census conducted in 2006, the city's population is 353,211 i.e. Three hundred and fifty three thousand, two hundred and eleven (NPC, 2006).

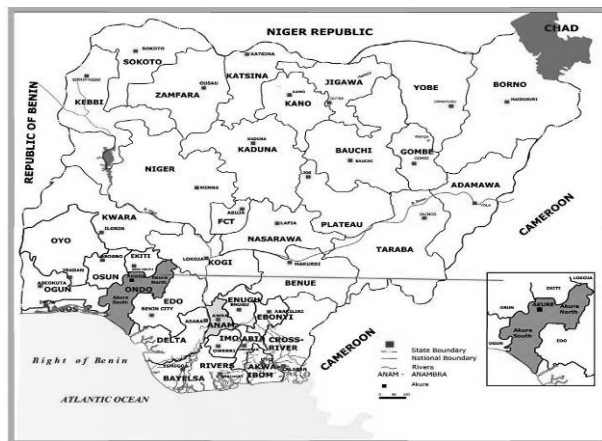


Figure 1: Map of Nigeria showing Ondo State and the study area (Source: www.google.com)

**Research Database:** Data for analysis was collected by the use of two sets of questionnaires administered on 220 residents of suburban communities and 10 community development agency staffs identified within the state. Ten (10) questionnaires of type A was administered on the community development department of Ondo State Ministry of Community Development and Co-operative Societies since they are the ones involved in carrying out developmental projects within the state while ten (10) questionnaires of type B each was administered on each of the twenty-two (22) surveyed communities residents and leaders/rulers, and this amounted to two hundred and twenty (220) questionnaires.

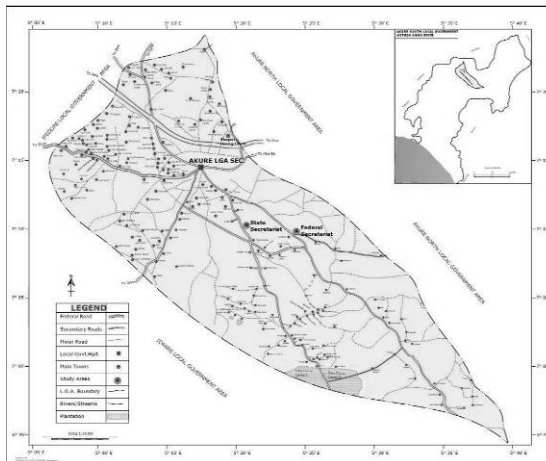


Figure 2: Map of Akure South Local Government (Source: [www.google.com/](http://www.google.com/) Ondo State map)

## RESEARCH FINDINGS AND DISCUSSION

Table 1 suggests that 30.5% of the respondents are involved in voluntary contribution only which means they employed the process of “Anti-participatory mode” in the course of providing, maintaining and sustaining the development project in their community.

Table 1: Mode/method employed on the provision, maintenance and sustenance of community development projects

Method Employed	Frequency	Percent (%)
1 Voluntary Contribution Only	61	30.5
2 Decision Making Only	30	15.0
3 Both Voluntary Contribution and Decision Making	99	49.5
4 Control of Resources and Regulatory Measures	10	5.0
Total	200	100.0

15.0% of the respondents are only engaged in decision making indicating that they are actively engaged in “manipulation mode” during the process of providing, maintaining and sustaining developmental projects while 49.5% and 5.0% participate in both voluntary contribution plus decision making, and control of resources with regulatory measures respectively connoting that they are involved in “Authentic public participation mode” and Incremental mode” respectively.

Table 2: Means of raising funds for community development projects

Means of Raising Funds	Frequency	Percent (%)
1 Community Development Levy	82	41.0
2 Donations	37	18.5
3 Assistance of Community Development Organizations	14	7.0
4 Government Assistance	67	33.5
Total	200	100.0

Table 2 suggests that most of the project carried out within the sampled communities is financed through community development levies such as monthly meeting

contribution, sum levied on each housing within the community. This is revealed by 41.0% from the shown table above. Also, the government usually renders assistance for community development; this has been justified by the Ministry of Community Development and Co-operative Societies programmes carried out within the various communities in the state. For examples, in Ipinla community, the electrification project is done through government and community assistance. Hence much project is not done by the assistance of community development organizations since this is evidenced by 7.0% of the respondent's view.

In Ajipowo ogundipe community, some of the projects carried out through community development levies using community participation process include the replacement of wooden electric poles with concrete electric poles, and naming of streets in order to assist visitors in reaching their destinations without much difficulty. Also in Gaga community, they employed community participation techniques in executing projects such as road upgrading and maintenance, provision of police post and a primary school while the maternity health centre in the community was rented to the community by a member of the community and rent paid by the community members.

Table 3: Stage at which people participate in decision making

Stage	Frequency	Percent (%)
1 Project Implementation Stage	45	22.5
2 Non-participatory but Hearing Stage	22	11.0
3 Non-participatory but Government Expectancy	37	18.5
4 Conception through Implementation Stage	96	48.0
Total	200	100.0

48.0% shows that most of the respondents are involved in the community development project from conception through implementation stage indicating that they are actively engaged in the process. While least percentage of the respondents, 11.0% reveals that they do not participate in decision making process but are engaged at the hearing stage before the commencement of the projects while 18.5% indicates that they do not participate at all as they are expecting the government to carry out every needed projects for them and 22.55% shows that the people are involved only at the implementation stage. This therefore tells us that since the people are involved in the conception of the projects up to its implementation stage, the people of the community are partakers of the management of the completed projects because they are the end users of the projects and they also knows the source from which the project emanates from.

Table 4: Method of executing community projects

Method	Frequency	Percent (%)
1 Community Joint Effort	73	36.5
2 Government Provision	101	50.5
3 Donations from Charity Organizations	9	4.5
4 Individuals Responsibility	17	8.5
Total	200	100.0

Table 4 above reveals that 50.5% of most of the development carried out within the sampled areas are through government provision, such as: road project, electrification,

water supply and so on. 36.5% of the project was also carried out through the joint efforts of the community members such as drainage, electricity maintenance, roads maintenance etc. This shows that the government in conjunction with the community efforts is the various ways by which projects are being carried out even though there is support from individual's and donations from charity organizations as revealed by 8.5% and 4.5% respectively. Such charity organizations are European Union and Micro-Projects Programme in Six States of the Niger-Delta (MPP6) which are a little bit active in the state

Table 5: Problems encountered in the process of community development

Problems	Frequency	Percent (%)
1 Lack of Funds	100	50.0
2 Non Co-operative Attitude of the Members of the Community	30	15.0
3 Lack of Motivation by the Government	70	35.0
Total	200	100.0

From Table 5 above it can be deduced that a limiting factor in carrying out project within a community is due to the non availability of funds. This is evidenced by 50.0% of the respondents view. 35.0% of their view also suggests that government does not motivate them enough to be able to carry out a standard project. The study also revealed that most of the project in the community which requires government assistance are usually delayed or takes a long process before implementation hence the community residents do come together to levy themselves and finally come up with a minimum project within their capacity even through there still appears to be a non co-operative attitude from some of the members of the community as shown by 15.0% of the responses.

Table 6: Comparison between community participation projects and government-initiated projects

Response	Frequency	Percent (%)
1 Yes	150	75.0
2 No	50	25.0
Total	200	100.0

The respondents are of the opinion that community participation based projects are better sustained than government initiated projects, since they are the ones who carry out the projects themselves, they usually maintained the projects prudently and that they carefully exhaust the development unlike government initiated projects that they do handle with levity since they assume that the funds used in bringing up the project is not from their own purse; hence such project is not usually handled with care.

The table 7 shows that 50.0% of the respondent's engages in community development exercise because of the love and passion they have for the growth of their community and the fact that they are the end users of whatever project been carried out in their community. 25.0% responded that they are actively involved as a sign of belonging to such community or since it is their major responsibility to develop their own community without waiting for the government while 20% and 5.0% are of the view that they participates just to be a part of history.

Table 7: Reason for participating in community development projects

Motivation	Frequency	Percent (%)
1 Love and Passion for the Growth of the Community	100	50.0
2 Being Part of History	40	20.0
3 Urgency of Need	10	5.0
4 Sense of Belonging/Responsibility	50	25.0
Total	200	100.0

## POLICY RECOMMENDATION AND SUGGESTIONS

Community participation calls for people to participate in planning, implementing and managing their local environment. Community participation in sub-urban development means a readiness on the part of both local governments and the citizens to accept equal responsibilities and activities in managing their surroundings so as to achieve a sustainable and equitable well-planned environment.

Participation means a commitment to bring to the table resources, skills and knowledge for achieving a common purpose, and a respect for the capabilities and capacities of all partners involved in the community development. It means that the value of each group's contribution is seen, appreciated and used. The honest inclusion of a community's representatives as "partners" in decision-making makes for successful community participation.

In this paper, it is noted that communal efforts towards the development of the sub-urban areas has helped in solving the immediate needs of the identified communities in Akure. The study has used the questionnaire to source for data among 220 residents in the 22 communities identified and 10 staffs of the Ministry of Community Development and Cooperative Societies; it has also adopted the simple random sampling technique to select the communities investigated. Data analysis shows that:

Most of the projects carried out within the sampled areas are through government provision.

- i. Community participation based projects are better sustained than government initiated projects because the community residents usually handle and operate these projects with care.
- ii. The commonest means employed in the provision, maintenance and sustenance of community development is through "*Authentic Public Participation Mode*" denoted suggesting that the people are involved in both voluntary contribution and decision making process.

In order solve the problems confronting the government in its bid to raise the standard of the sub-urban communities, it is worthwhile that the government should organize a programme that will orient and educate the citizenry the necessity for them to participate fully in the development of their own neighbourhood themselves through self-help activities since the government cannot satisfy the immediate needs of all the communities within its jurisdiction at a goal.

It is also worthy of note that the government should arrange for re-orientation and re-educational programmes for members of the communities to sensitize and motivate them towards these activities. The enlightenment programmes will aid in training,

community development capacity building, and self help programmes and strategies e.t.c.; The government, either the State or Local, should also endeavour to conduct a socio-economic survey on the intended beneficiaries of the projects before embarking on any project. This will enable the government to ascertain the need of the community and offer ample opportunities for the citizens to offer suggestions and make decisions as regards the location and eventual execution of the projects. Government should form partnerships with civil society in general and community-based organizations in particular to assist community development and social well-being within poor urban communities, squatter and other informal settlements in the urban and semi-urban areas of cities and towns and improve access to essential services.

In order to adequately attend to the problem of finance, there is need for the structuring of a formidable institutional arrangement that shall be equipped with the capacity for action. Government should strengthen existing community organizations and also foster the development of new ones in communities that are lacking. For example such as NGOs such as HIV campaign organizations, and CBOs such as the association of market women.

Finally, there is need for the introduction of capacity building at the community participation level. Government should embark on collective training of community target groups such as leaders of the various community organizations as well as the Community Development Association executives.

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# **AN ASSESSMENT OF THE EFFECTIVENESS AND EQUITABILITY OF ACCESS TO FEDERAL MORTGAGE BANK OF NIGERIA'S FINANCES FOR HOUSING (1992 - 2008)**

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Previous housing strategies in Nigeria could not facilitate access to good quality housing for the majority of citizens. Attempts to solve the problem include successive revision of the land use Act; development of appropriate building materials; and the establishment of two-tier mortgage finance system. Also, the National Housing Fund (NHF) was introduced in 1992. However, access to Federal Mortgage Bank of Nigeria (FMBN)'s loans had been adjudged low and lopsided. The aim of this study is to assess the performance of housing development finance of the FMBN with the view to establishing the level of efficiency of the loans disbursed between 1992 and 2008. The only hypothesis of the study assumed no significant relationship between the magnitudes of average pooled finances lent by the FMBN for various incomes housing and the respective population of each income group that accessed the finances in the states studied. Data was collected via questionnaires that were administered on the FMBN, and mortgagors through random sampling. Time-series and 2-way ANOVA were used for the data analyses. The income group and states at greatest disadvantage in term of access to the loans were established. Thirty impediments were found to be responsible for poor access to FMBN's loan by the low-income earners during the period under study (1992 - 2008). Eighteen impediments were traced to the low-income earners, four to the Mortgage Institution, and eight to the Public Sector in Nigeria. The mortgage system is recommended for restructuring to enable better performance.

Keywords: mortgage finance, low-income group, personal savings, performance.

## **INTRODUCTION**

In Nigeria, the stringent conditions for access to loans for housing have made access to good quality housing difficult for the majority of citizens (Ope 2005). The problem appears traceable to the difficulties of access to funds, land, and tedious procedure for acquisition of right of title to land, and high costs of materials and labour (Ajanlekoko 2001). On one hand, the country is characterised by huge population, rapid growth, rapid urbanisation and a history of unsuccessful attempts at developing realistic strategies for easy access to vital resources for housing (FGN, 2006; Kaltho 2008). The impacts of these malfunctions are manifest most glaringly, in derisory and poor quality residences of low-income earners (Ural 2006).

Since colonial times, the measures employed to alleviate the housing plights of the various strata of the population favoured only a privileged few – these were the

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aristocrats, civil servants, and the armed forces. These measures include the construction of official residences for the aristocrats; payment of rent-subsidies to staff, renting of accommodation in lieu of subsidy, and the construction of housing units for various income groups - a feat which the Federal Government initiated on a national scale in the mid 1970s. This marked the beginning of coordinated approach to resolve mass-shortage of good quality housing in Nigeria (Amdi 1984).

This style of public sector approach to remedy the shortage of good quality housing was found to be full of shortcomings, amongst which were the exclusion of self employed and the neglect of rural areas (Yusuf 2005). The housing units were transient because occupants vacated upon leaving service (Yusuf op. cit.). Also, there were objectionable location of the housing units; and cultural inappropriateness of the house designs (Zubairu and Yari 1996). Again, there were no attempts to relate the housing supplies to the true indicators of demand. Consequently, the allocation was by ballot which made a jest of the housing programmes (Dwyer 1990; Mosaku 1997). In addition, the capital spent to construct each unit of house was enough to construct several times each of the housing units (Mosaku 1997; Ajanlekoko 2001). Consequently, the housing units became insufficient, and priced out of the economic reach of the same low and middle-income earners in the country (Ajanlekoko 2001; Atagher 2008).

In response to the shortcomings, the Federal Government of Nigeria introduced new measures to address the persistence of poor access to good quality housing by the majority of citizens. The measures include attempted revisions of land use Act, development of appropriate building materials, auctioning of substantial number of public housing units to occupants, and the establishment of Federal Mortgage Bank of Nigeria (FMBN). The conversion as well, empowered the FMBN to coordinate mortgage lending on a nation-wide basis (FMBN 1998).

Act No. 53 of 1989 provided the framework for the establishment and operation of Primary Mortgage Institutions (PMIs) with the FMBN as apex institution. This plan augmented the operations of the FMBN and decentralised the collection of mortgage loans by eligible persons. Then, the National Housing Fund (NHF) introduced in 1992 made it mandatory for workers to compulsorily contribute 2.5 % of their basic earnings. The custody of the NHF was ceded to the FMBN. This measure provided the FMBN with a continuous pool of money for use in funding housing development in Nigeria (FGN 2006; FMBN, 2006, 2008).

## **BACKGROUND AND PROBLEM STATEMENT**

From the introduction of the NHF in 1992 to 2008, substantial funds were lent by the FMBN to persons and organizations as mortgage to address the shortage of good quality housing in Nigeria. However, access to the loans was adjudged low and lopsided to the inconvenience of the low-income earners in the country (Ayorinde and Morenikeji 1994; Anne and Eniola 2001; Okonkwo 2004; Sambo 2006; Bala 2007a; Ibid 2007b). The mortgage establishment denied unfairness in deals and insisted that the critics did not consider the total efforts made by the Bank to ease housing shortage in Nigeria through direct loans to developers and through loans to individuals via the PMIs (FMBN 1998; Ibid 2008a; Atagher 2008) Therefore, what is the truth in these contending claims? In other words, to what extent did income levels and population of the mortgagors influenced the dual finances lent by FMBN during the period between 1992 and 2008 in twenty six selected states of Nigeria? Where does the problem lie?

How could recurrences be prevented? The searches for the answers to these questions constituted the focus of this study.

A review of the related literature indicated that the granting of mortgage to a member of any of the three income groups in Nigeria is a function of the individual saving well above 10 % of the cost of the house to be built or purchased. The applicant must have contributed 2.5 % of his or her basic monthly earning to the National Housing Fund for six consecutive months prior to the application for loan. Additionally, the applicant tenders evidence of guarantorship of the mortgage and certificate of occupancy of the land for his housing project or a warranty to Public - Private - Partnership (PPP) housing-programme for which he is to be a beneficiary. However, attaining equity is a function of satisfying the conditions for loan, sufficient funding and timely release of the loans to beneficiaries. Employers of labour intervene as guarantors of their employees' mortgage. The Public Sector ensures access to land. In addition, the related literature indicated the existence of four methods of Public Private Partnership (PPP) for housing delivery to match demand. They are; (1) Build-operate-transfer (BOT), (2) Build-own-operate-transfer (BOOT), (3) Build-transfer-lease-operate (BTLO), and, (4) Build-own-sell (BOS), whose choice depended on clients awareness and access to funds.

Previous studies that related the number of families moved from sub-standard to standard housing for a given expenditure were conducted by; Silberman (1978); Amdt (1984); Ope (2005); Ayorinde and Morenikeji (1994); Sambo (2006); and Bala (2007b). Similarly, studies on capital funding for Housing construction by Giwa (1988), Mogbo (1992), and Timothy (2000) were found restricted in scope, and findings. None of the studies related the collective feat of the FMBN's dual finances lent during the period between 1992 and 2008 and the income-demography of the people that accessed the loans in the various states of Nigeria.

Also, studies closest to the one being contemplated like Ayorinde and Morenikeji (1994); Anne and Eniola (2001); and Atagher (2008) lumped-up the mortgage disbursed, as well as, the population that accessed the loans. Consequently, little could be made out of the information they provided. This study examined the attempt by the FMBN to ease housing shortage in Nigeria through the various volumes of loans granted for low, middle, and high-income housing during the period between 1992 and 2008 at National level of mortgage co-ordination in Nigeria.

Burnett, (2006) observed that: "The fundamental issues in housing are demographic." Also, Solomon (2007) asserted that: "demography assesses the cost effectiveness of a program in closing the housing gap". Therefore, an assessment of relationships between the averages of FMBN's dual finances lent for low, middle, and high-income housing during the period between 1992 and 2008 and the population of persons that accessed the loans in each income group will be statistical.

## **RESEARCH DESIGN**

This study is investigative, exploratory, and comparative. It is designed to unearth five sets of data and analyze the relationships between four of them for significance. The four sets of data are;

(i), the volumes of dual finances lent for low, middle, and high-income housing by the FMBN through direct disbursements to the accounts of property developers and through the PMIs to NHF-contributors during the past 16 years (1992 - 2008) in 26 selected states of Nigeria.

(ii), the types and number of housing units realized from the dual finances lent by the FMBN for the various incomes housing in each selected state during the past 16 years.

(iii), the character of relationships between the magnitudes of average pooled finances given out for various incomes housing and the number of persons that accessed the loans in each income group in the selected states of Nigeria.

(iv), the reasons for poor access to mortgage by especially, the low-income earners during the period between 1992 and 2008 in those selected states of Nigeria.

The interlude 1992 to 2008 was chosen for the study because;

1992 was the year of commencement of 2.5% compulsory deductions in favour of the National Housing Fund (NHF) from the basic earnings of Nigerian workers (FMBN, 1998).

1992 to 2008, marked the first sixteen years of mortgage operation by the FMBN after its empowerment to the extent of all resources accruing to the NHF. It was during this period (1992 - 2008), that the population in Nigeria grew from 120 million in 1991 to 150 million in 2006 (NPC, 2006).

Also, it was during this interlude that additional states and local government areas were created, and the salaries of workers reviewed upwards (FRCN, 2008). The housing demand in the country became obvious and the expectations on FMBN's intermediation high.

Therefore, what are the realities of the performance of the loans disbursed (1992 - 2008) by the FMBN in relation to the housing demands of the various income persons that accessed the loans? The study was carried out in three parts, namely; (1) critical review of related literature, (2) field work, and (3) derivations (from the reviewed literature and field work).

Data was collected through the use of two separate questionnaires. Type-I questionnaire was used to source data from official records of the FMBN and Type-II questionnaire was employed to seek the views of respondent on the reasons for poor access to FMBN's loans by low-income earners. The stratified random sampling method was used to select the 26 states studied. The study examined the attempt by the FMBN to ease housing shortage in Nigeria through the volumes of mortgage lent for low, middle, and high-income housing during the period between 1992 and 2008. The instruments used for the analyses are time series and 2-way ANOVA. For the convenience of analysis, the 16 year study time-frame (1992 to 2008) was broken into four segments of four years each as follows; (a) 1992 – 1996, (b) 1996 – 2000, (c) 2000 – 2004, and (d) 2004 - 2008. This facilitated a grasp of the trend of disbursement of mortgage by the FMBN during the 16 year time-frame.

In the study, simple and multiple regression analyses were used to assess the relationships between values of the variables. The Statistical Package for Social Scientists (SPSS 13) and the Microsoft Excel (Xp) were employed to reduce the labour of manual plotting of graphs and calculations.

## **HYPOTHESIS**

H<sub>01</sub> - There is no significant relationship between the magnitude of FMBN's average pooled finances lent during the period between 1992 and 2008 for particular income housing in the states under study and the population that accessed the finances in that income-group.

## MATERIALS AND METHOD

The numerical values in Table 1 were the ones used in conducting the statistical analyses in this work. The values in the table were compiled by summing the different values of average pooled funding disbursed, persons granted the funds, and the average number of housing units realized from the funds during the four segments of the study period (1992-1996; 1996-2000; 2000-2004; and 2004-2008).

Table 1: Averages of the dual finances lent (1992 -2008) by the FMBN; average housing units realized; and the class/population of the Bank's mortgagors

Name of State in Nigeria		Average pooled finances lent (1992 - 2008) by the FMBN and the population of mortgagors per category Housing.									
		2 Habitable room spaces low-income Housing			3 Habitable room spaces middle-income Housing			5 Habitable room spaces high-income Housing			
		A	B	C	D	E	F	G	H	J	
1	Abia	85.8	58	59	211.9	108	105	55.1	16	18	
2	Akwa Ibom	18.8	26	26	61.7	32	31	44.4	12	13	
3	Anambra	08.3	152	156	83.0	44	45	47.4	16	17	
4	Bauchi	52.8	149	105	655.3	355	388	154.8	51	57	
5	Benue	98.6	83	85	698.0	466	454	20.3	07	08	
6	Cross-River	437.7	544	493	193.1	98	96	23.1	08	10	
7	Delta	42.1	52	53	38.6	20	19	22.8	06	08	
8	Ebonyi	44.8	62	65	51.5	27	26	51.4	17	19	
9	Edo	313.5	578	499	193.1	95	90	68.7	23	25	
10	Enugu	93.1	366	447	38.9	19	18	103.1	34	38	
11	FCT, Abuja	246.0	1844	1386	4514.1	2158	2103	171.7	57	63	
12	Gombe	251.5	394	295	500.6	252	245	115.8	35	35	
13	Kaduna	77.2	95	100	258.5	119	116	34.7	12	13	
14	Kano	82.0	233	175	347.3	149	95	31.5	09	10	
15	Katsina	39.4	87	91	464.4	205	143	35.1	12	14	
16	Kebbi	32.6	83	85	664.6	337	328	34.9	15	15	
17	Kwara	13.7	35	45	346.7	195	190	37.2	12	13	
18	Lagos	142.9	495	465	987.5	488	475	82.3	30	37	
19	Nassarawa	101.8	143	154	194.9	106	104	31.3	09	09	
20	Niger	37.5	110	140	154.1	78	76	24.3	08	09	
21	Ogun	118.5	732	601	1175.1	588	575	100.4	32	34	
22	Ondo	83.4	270	250	343.5	160	120	34.7	12	13	
23	Osun	41.0	103	135	39.0	20	20	34.0	11	12	
24	Rivers	219.0	312	354	357.6	179	178	57.0	17	19	
25	Taraba	108.3	131	148	88.1	49	48	39.7	13	13	
26	Yobe	165.4	608	491	786.5	439	428	98.6	31	32	
Total		4,241.8	7,645	6,894	3,447.6		6,786	6,516	1,554.3	505	554

Notes: A - Average pooled finances lent (₦' M); B - Average of housing units realized; C - Persons granted; D - Average pooled finances lent (₦' M); E - Average of housing units realized; F - Persons granted; G - Average pooled finances lent (₦' M); H - Average of housing units realized; J - Persons granted

The FMBN's average pooled funding in every state was obtained by adding the finance disbursed to developers for a particular income-housing in the state to the finance disbursed to individuals in the same state for the purchase of that kind of income-housing and dividing the sum by two. In all the analyses, the independent variables (on x-axis), is the population of each class of mortgagors. The dependent variable (on y-axis) is the respective average pooled funding to the particular income housing by the FMBN during the period between 1992 and 2008.

## RESULTS

Graphical analysis of the relationships between the variables of the study

(A) Time-series Analysis of the financial disbursements by FMBN for Housing (1992-2008). (a.1) FMBN's disbursements for low-income housing 1992-1996; 1996-2000; 2000-2004; and 2004-2008

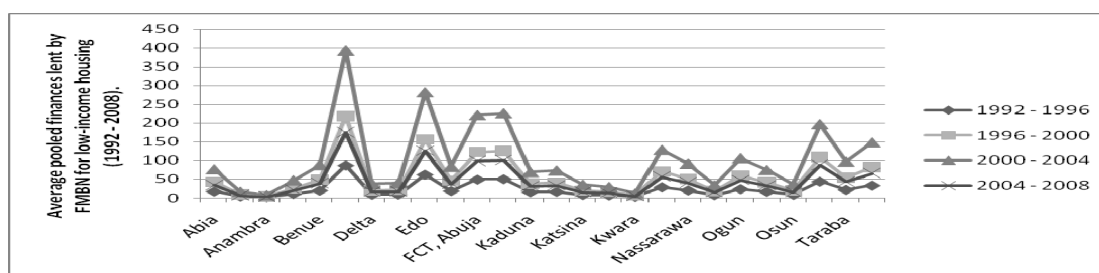


Fig 1: Trend of FMBN's loan disbursements for low-income housing (1992 – 2008) in 26 selected states of Nigeria. Source: Author's analysis of data from FMBN, 2009. (a.2) FMBN's disbursements for middle-income housing 1992-1996; 1996-2000; 2000-2004; 2004-2008

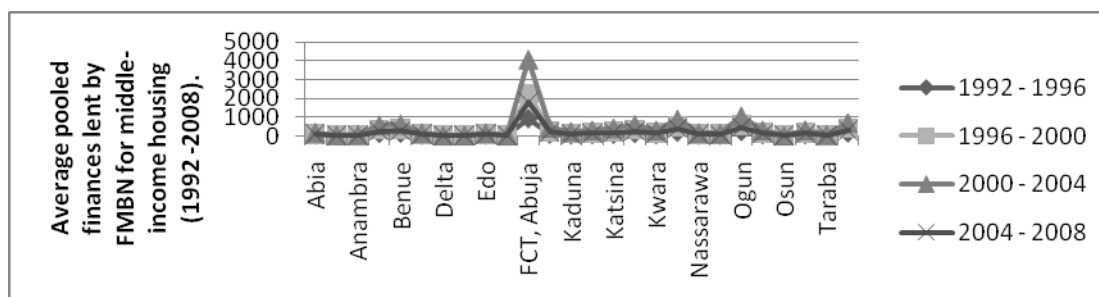


Fig 2: Trend of FMBN's loan disbursements for middle-income housing (1992 – 2008) in 26 selected states of Nigeria. Source: Author's analysis of data from FMBN, 2009. (a.3) FMBN's disbursements for high-income housing 1992-1996; 1996-2000; 2000-2004; 2004-2008

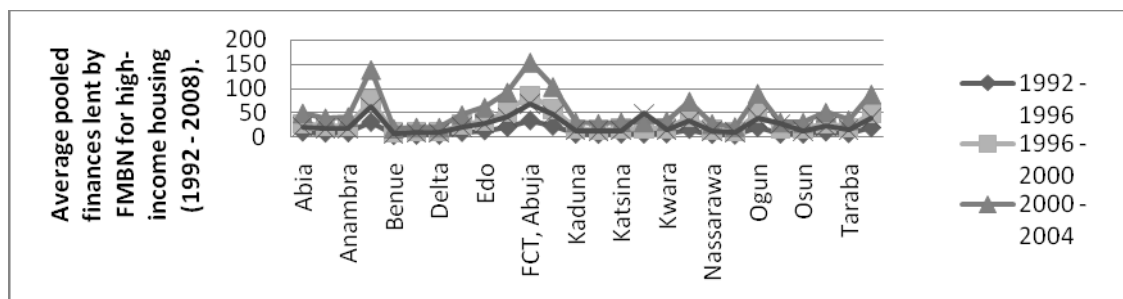


Fig 3: Trend of FMBN's loan disbursements for high-income housing (1992 – 2008) in 26 selected states of Nigeria. Source: Author's analysis of data from FMBN, 2009.



(a1.) Graphical relationships of the Overall values of the variables to test hypothesis one at National level.

[i.] Graphical assessment of the FMBN's average pooled finances lent for Low-income housing superimposed on the graph of the population of Low-income persons that accessed the loans.

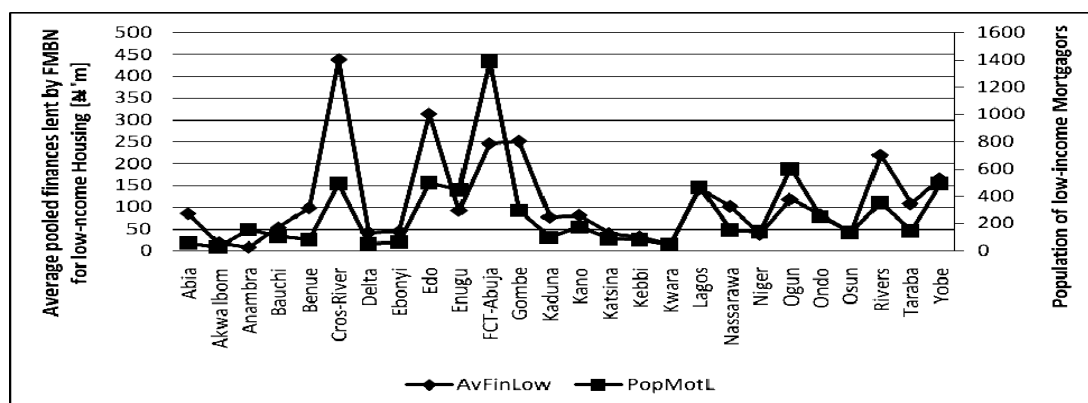


Fig. 4: Average pooled finances lent by FMBN for Low-income Housing and the population of FMBN's Low-income Mortgagors (1992 - 2008)

## Comments

The super-imposed graphs of average pooled finances disbursed for low-income housing and the Population of low-income mortgagors demonstrates that lots of funds had been committed to the low-income housing development in 26 states with no matching results. This strongly suggests the choice of wrong intervention parameters, ill-informed approaches to the housing process, and poor coordination by the authorities that matter in the 26 states studied.

[ii.] An assessment of graphs of FMBN's average pooled finances lent for Middle-income housing superimposed on the graphs of the Population of Middle-income persons that accessed the mortgage.

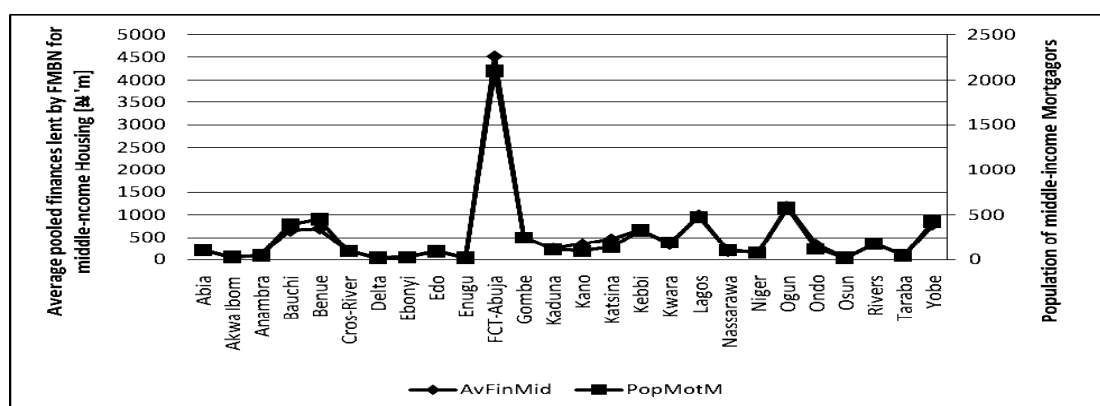


Fig. 5: Average pooled finances lent by FMBN for Middle-income Housing and the population of FMBN's Middle-income Mortgagors (1992 - 2008)

## Comments

Result of graph of average pooled finances lent for middle-income housing and the population of middle-income earners that accessed FMBN's loans show extremely strong harmony between the magnitudes of the two variables.

[iii.] An assessment of graphs of FMBN's average pooled finances lent for High-income housing superimposed on the graphs of the Population of High-income persons that accessed the mortgage.

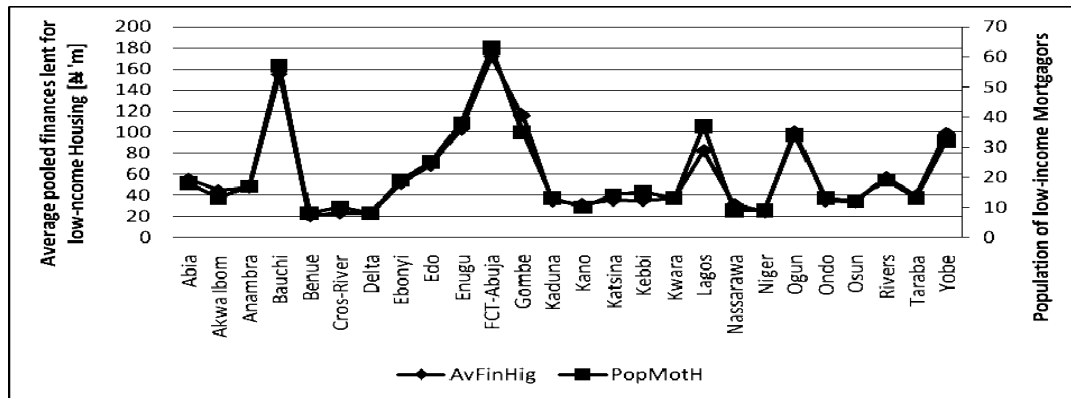


Fig. 6: Average pooled finances lent by the FMBN for High-income Housing and the population of FMBN's High-income Mortgagors (1992 - 2008)

## Comments

Result of graph of average pooled finances lent for high-income housing and the Population of high-income persons that accessed FMBN's loans show a strong harmony between the magnitudes of the two variables.

## Results of the Correlation Analyses on the data sourced from FMBN

(a) Average pooled finances lent per category of housing units (1992 - 2010) and the respective Population of FMBN's mortgagors per income group – National

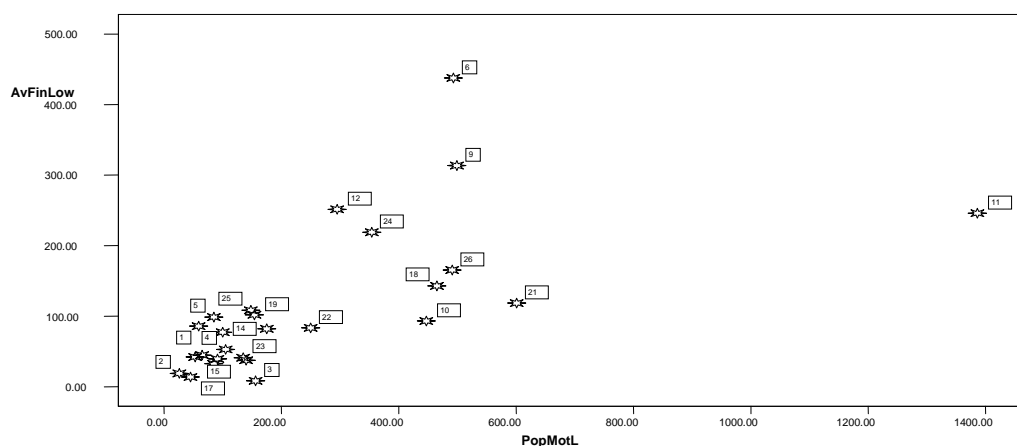


Fig. 7: Average pooled finance lent for low-income Housing and the population of FMBN's low-income mortgagors 1992 - 2008.

Comments on the results of Regression Analysis AvFinLow and PopMotL: The magnitudes of the two variables are positively related with weak  $R^2$  value of 38.0%. Subsequent quadratic and cubic transformations gave better lines of fit with  $R^2$  values of 53.7 % and 54.0 % respectively. P value  $0.75 > 0.050$ . Therefore,  $H_{01}$  stands accepted.

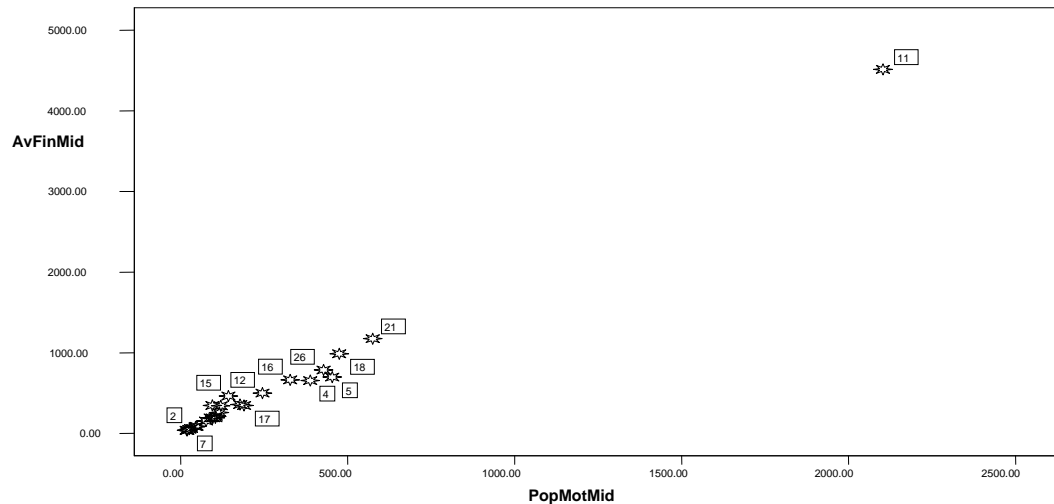


Fig. 8: Average pooled finance lent for middle-income Housing and the population of FMBN's middle-income mortgagors 1992 - 2008.

#### Comments on the results of Regression Analysis AvFinMid and PopMotM:

The magnitudes of the two variables are positively related with extremely strong  $R^2$  value of 99.5%. Subsequent quadratic and cubic transformations gave about the same lines of fit with  $R^2$  values of 99.4 % and 99.4 % respectively. P value  $0.01 < 0.050$ . Therefore,  $H_{01}$  stands rejected.

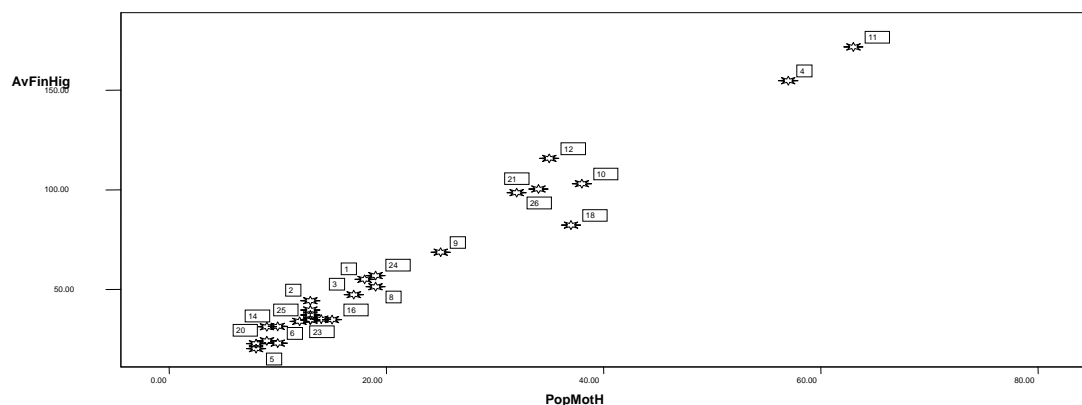


Fig. 9: Average pooled finance lent for high-income housing and the population of FMBN's high-income earners mortgagors 1992 - 2008.

#### Comments on the results of Regression Analysis AvFinHig and PopMotH:

The magnitudes of the two variables are positively related with strong  $R^2$  value of 98.6%. Subsequent quadratic and cubic transformations gave about the same lines of fit with  $R^2$  values of 97.3% and 97.3% respectively. P value  $0.02 < 0.050$ . Therefore,  $H_{01}$  stands rejected.

Table 2: Impediments that militated against the access of low-income earners to FMBN's primary loans during 1992 to 2008 in the 26 states studied

[1] Very low earnings and high cost of living. [2] Unemployment.	1. Non-saving due to low earning.	Traceable to the applicant.
[3] Lack of awareness of the mortgage scheme. [4] Exemption from participation in the mortgage scheme.	2. Non-participation in mandatory contribution to National Housing Fund.	
[5] Perception of self status. [6] Ignorance on how to access the loans. [7] Doubts about the sincerity of scheme. [8] Religious restrictions on usury.	3. Non-application for mortgage.	
[9] Body guarantying the loan not recognized in law. [10] Guarantor declines responsibility (out of the fear of risks).	4. Lack of guarantor to mortgage.	
[11] Does not have a land and is yet to obtain one. [12] Land in dispute (legal action instituted).	5. Non-possession of land for the project.	
[13] Land-certification under process. [14] Non-possession of exemption certificate by BOT/PPP clients.	6. Non-possession of the Certificate of Occupancy of land for the project	
[15] Non-possession of above 10 % initial cost of house. [16] Non-possession 30 % initial costs by developer.	7. Non-possession of the initial payment of the cost of house.	
[17] Affordability, mortality age (65 years), and refund. [18] Ambiguity in aspects of request.	8. Unrealistic pricing of construction works/housing unit in relation to the mortgage applied.	
[19] Loan ceilings for mortgage (N5 million max. per house). [20] Missen vital documents (out of sabotage or carelessness). [21] Limited fiscal capacity of the Banks. [22] Absence of viable capital market in the country.	9. Legal restrictions on the Mortgage Institution. 10. Lack of funds to honour all applications.	Traceable to the Bank.
[23] Non-inputs by end-users of housing schemes. [24] Non-patronage of techno-cultural and environmentally-friendly options for housing at comparable costs. [25] Inadequate grasp of the minimum requirements for human habitat. [26] Housing supplies not in harmony with indicators of demand [27] Delays and abandonment of projects.	11. Lack of informed approach on ways to meet the housing demands of the people.	Traceable to the Authorities.
[28] Effect of multiple taxations on wages and tariffs. [29] Effect of sanctions, and embargos on costs. [30] Inability of Insurance Premiums to cushion replacement costs.	12. Lack of control over factors that caused inflation and hence, drop in the value of naira.	

## DISCUSSION

Two forms of analyses (time-series and 2-way ANOVA) were carried out. The results were found as follows; the time-series graphs have established the patterns of disbursement of loans by FMBN and the relationships between the loans and the population of mortgagors during the 16 year time interlude. The correlation between the population of the Bank's low-income mortgagors and the magnitude of average pooled funding to low-income housing by the Bank during the period understudy (1992 – 2008) in the 26 states studied was found to be positive but weak. The values of the coefficients of correlation ( $R^2$ ) were found to range between 38.0% and 54.0%. All the transformations from linear, to cubic, and quadratic equations only produced better lines of fit between the scatter plots of the values of the two variables. The experiment was found to be statistically non-significant ( $p > 0.050$ ) for the low-income mortgagors and funding. This led to the acceptance of  $H_{01}$  and the rejection of  $H_1$  for the population of FMBN's low-income mortgagors and average pooled funding to low-income housing.

30 impediments were found to be responsible for poor access to mortgage by the low-income earners in the 26 states studied. The low-income had least access to the loans. This is despite the lots of talks about facilitating access to good quality housing for low-income earners in Nigeria by the FMBN, state governments, and developers (Ayorinde and Morenikeji 1994; Anne and Eniola 2001; Okonkwo 2004; Bala 2007a; Ibid 2007b; Kaltho 2008). Serious doubts are being cast on the ability of the FMBN's current mortgage arrangement to match the housing demands of particularly, the low-income earners in the states studied.

## CONCLUSION

Weak positive correlations characterised the relationships between the population of FMBN's low-income mortgagors and the magnitude of average pooled funding to low-income housing by the FMBN during the period between 1992 and 2008 in 26 states studied. The values of the coefficients of correlation ( $R^2$ ) were found to range between 38.0 % and 54.0 %. All the transformations from linear, to cubic, and quadratic equations only produced better lines of fit between the scatter plots of the values of the two variables. None of the experiments was found statistically significant ( $p > 0.050$ ). This led to the acceptance of  $H_{01}$  and the rejection of  $H_1$ .

The establishment of weak relationships and the acceptance of the null hypothesis ( $H_{01}$ ) authenticated significant difference in the relationships between FMBN's average pooled funding for low-income housing and the population of the Bank's low-income mortgagors during the period 1992 to 2008 in the 26 states studied. This discovery confirmed the despondency of the current mortgage plan and the ineffectiveness of the Housing Supply Channels patronized in the recent past by the FMBN through developers with the support of state governments in meeting the housing demands of low-income earners in the 26 states studied.

30 impediments were identified as responsible for the poor access to FMBN's primary loans by the low-income earners in the 26 states studied. However, for quick reference, the 30 impediments were regrouped into 12 key factors as listed in Table 2. By virtue of these discoveries, serious doubts has been cast on the ability of the existing mortgage arrangement to match the housing demands of particularly the low-income earners in the 26 states studied. Evidences for this assertion are provided by

Figs. 4 and 7. A restructuring of the mortgage system is recommended. Also, attempts to ease access to mortgage must address all the identified impediments.

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# AN EVALUATION OF PHYSICAL TRANSFORMATION OF RESIDENTIAL BUILDINGS IN GOVERNMENT ESTATES IN SOUTH WESTERN, NIGERIA

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Globally, housing sector represents the largest proportion of the built environment. The need to sustain this sector in the face of growing World population and ever expanding urbanization necessitate this empirical study, which evaluated the extent of physical transformation of residential buildings in government owned estates in South-Western Nigeria. This will be with the aim of developing a framework for improving housing conditions. Three housing estates in three states were selected for data collection. Data for the study were collected through observations, interview schedules and structured questionnaires administered on 474 transformers, 360 non-transformers and 87 professionals in charge of housing provision in public institutions. The data were analyzed using descriptive statistics in form of frequency tables, percentages and charts and chi-square test and correlation analysis. Multiple regression analysis was done to develop empirical models for predicting the rate of building transformations. The study examined the various factors that determined user's decisions to transform already occupied building, made a comparison of transformation activities and process among the studies estates, and identified the significant prediction variables influencing the building transformation. Findings indicated that people embarked on building transformations to provide those infrastructures that were not provided by government. Income level of occupants was the most important determinant variables associated with transformation process. Majority of respondents identified delay of approval of drawings (plan) and lack of cash flow as problems encountered in the process. The study also revealed that the building transformation is unguided and directed by market forces and individual interest. However, the physical features of the building affect housing transformation decisions rather than households' income or compositions. It is recommended that government should adopt an essential permissive attitude with control measures.

Keywords: physical transformation, transformer, non-transformer, residential building, infrastructure.

## INTRODUCTION

Atolagbe (2002) and Fadamiro et al (2004) argued that urban poverty is a reflection in poor housing conditions. To them, a process of carefully planned transformation of existing buildings and structures through "redevelopment, rehabilitation, renovation, conservation, preservation was a way to go.

The rapid rate of urbanization in Nigeria is noted to account for the depreciating quality of housing in the country urban centre. The urban centre themselves suffer deterioration infrastructure and service (Oladapo and Olotuah, 2007). Affordable and

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good housing constitute critical condition for the physical well-being and physiological need of human beings (Olokesusi, 2003). The situation in Nigeria is that about 60 percent of Nigerians can be said to be “homeless” persons (Federal Government of Nigeria, 2001). The current housing crisis in Nigerian has shown according to a research report by the security and exchange commission in association with the Mortgage Banking Association of Nigerian (2005), that the Federal Government requires #14 trillion to meet the deficit of over 14 million homes in Nigerian.

Habraken (1975) and Trpple (2000) have argued that government residential building cannot satisfy the need of the occupant because by its very nature, it is often built in the absence of consultation with future occupant. Sheuiya (2004) highlighted that apart from the acquisition of a building plan, the following factors contributed to the development and growth of informal settlements in Africa: high population growth rates; rapid rate of urbanization; slow economic growth rates; globalization; and inappropriate policies. Onibokun (1985) believed that housing difficult in Nigeria had been complicated by rapid growth, inflated real estates values, speculative activities, and influx of poor immigrants and lack of planning. To Onibokun (1985) then, physical transformation of existing buildings will manifest since “housing needs are manifested in overcrowding, in poor and inadequate social amenities, in unsatisfactory and unwholesome environmental conditions, and urban squalor in the absence of open space, in the over-development of land area leading to the over-crowding of building, in accessibility within residential areas and in scarcity and high costs of building materials.

Physical transformation of buildings, which usually unauthorised, had been going on in the urban centres of Nigeria. Olarewaju (2004) confirms that within a twenty year period, 1974 – 1993, residential property changed from 70.94% of the total land use to barely 39% in central Lagos. Similarly Nwuzi (1995) discovers that 76.0% of houses in Diobu, Port Harcourt were converted and structural modified from residential to non-residential activities without authorization.

While continued housing transformations which are triggered by the search for livelihoods among households in formal urban settlement and which are not strictly guided by statutory urban planning, are likely to increase, they can also cause public health problems such as residential and occupational health hazards (Sheuya, 2004).

## **STATEMENT OF THE PROBLEM**

Specifically, this research was intended to examine issues compelling occupants of residential estates in south western, Nigeria, who were dissatisfied with the existing structures to carryout unauthorized physical transformation of their dwellings.

## **THEORETICAL BASIS FOR PHYSICAL TRANSFORMATION OF RESIDENTIAL BUILDINGS**

The early works of physical transformations concentrated on the notions of allowing residents to have input into their housing condition (Steinberg, 1984; Benjamin 1985; and Beinart, 1971). Tipple (2000) asserted that every house is a work in progress, and that physical transformers express not just housing needs but that desire for identity, a sense of belonging and a search for status among neighbours. Equally, from the International conference of the United Nations (UNCHS, 1996) the Habitat agenda, countries of the world were committed to the idea that: promoting the redevelopment and the reuse of already services but poorly utilized, commercial and residential land

in urban centres in order to revitalize them and reduce development pressure on productive agricultural lands on the periphery (UNCHS, 1996 para 43). From this Habitat Agenda, countries were encouraged to: promoting of upgrading of existing housing stock through rehabilitation and maintenance and the adequate supply of basic services and facilities and amenities (UNCHS, 1996 para 40).

On housing transformation, Tipple and Ameen (1996) in Bangladesh, Tipple and Salim (1999) in Malaysia; Kardash (1999) in Egypt; Arimah (1999) in Lagos; Nwuzi (1995) in Port Harcourt and Sule (1986) in Calabar, numerous reasons were deduced as to why transformation were carried out. From the simple reason of adding more space to existing structure to fencing, search for additional income among the others, most of the physical transformations were not authorized by relative public agencies.

With the Nigerian population growth rate of 2.82%, one of the fastest in the world, and rapid urbanization which proportionally rise to 43.3% in 2000 (Report of Presidential Committee on Urban Development & Housing, 2001), in the face of massive requirements for new housing needs which are estimated to be in the region of demand for 200,000 homes per annum (Mortgage banking Ass. Of Nigeria (2005); Sheuya (2004) has envisaged that continued housing transformations must be panacea for bridging the gap.

Harrison (1982) was of the concept that “while western cities are thinning out, as people move to the suburbs, third world cities are growing denser, infilling their empty spaces, building layers on layer of unsafe structures.

## **ANALYTICAL FRAMEWORK AND DATA SOURCES**

Information and data used in this paper were collected by the use of three types of questionnaires. The first type was used to collect information from occupants of residential buildings in government estates that have extended and altered their buildings. 850 respondents were randomly selected from the three housing estates of Ikeja, Old Bodija and Ijapo from which 474 questionnaires were retrieved and analysed. The second set of questionnaires was also administered on occupants that did not transform (Non-transformers). 500 respondents were randomly selected, from which 360 questionnaire were retrieved and analysed. The third set, were administered on professionals, responsible for the management of the study estates, 120 were randomly distributed, out which 87 were retrieved. In summary, out of the 850, 500 and 120 of the first, second and third sets of questionnaire distributed to respondents 474, 360 and 87 were retrieved respectively in analyzable form giving a response rate of 80%, 70% and 76%. The percentages were considered sufficient for the study based on the assertion of Moser and Kalton (1971) that the result of a survey could be considered as biased and of little significance if the return rate was lower than 30 – 40%.

Field work commenced in August 2008 and ended in December, 2008. The questionnaire contained forty nine (49) variables which were investigated and they covered areas such as Income, Household size, Educational level, transformation, cost of transformation, duration, space added to building, source for money, tenure, type of building, other uses for transformed building, home based enterprises (HBE), Designing, construction, quantifying and management of transformed building.. Analysis was carried out through the use of simple frequency tables, chi-square test and binary logistic regression.

## RESEARCH QUESTIONS

1. What are the social economic characteristics that distinguish occupants that transformed their buildings (transformers) from those that did not (non-transformers)?
2. What are the factors that influenced users' decision to transform occupied buildings in the study area?
3. To what extent are the professional who manage the study estate involved in physical transformation process?
4. Are the physical transformation activities and process different from one study estate to another?

## RESEARCH AIMS AND OBJECTIVES

The aim of this study is to evaluate the extent of the physical transformation of residential buildings in government estate with a view to develop a framework for improving housing conditions in south western, Nigeria .The specific objectives were set to:-

1. Evaluate the socio-economic characteristics that distinguish occupants that transformed their building (transformers) from those that did not (non-transformers)
2. Evaluate the factors that influenced user's decision to transform occupied building in the study area.
3. Evaluate the involvement of professionals who manage public institutions responsible for housing in the physical transformation process in the study estates.
4. Compare transformation activities and process in the study estates
5. Develop model for factor that determine decision to transform building in the study area.

## RESEARCH HYPOTHESIS

H0<sub>1</sub>: There is no significant relationship between socio-economic characteristics of occupants that transform their buildings from those that did not.

H0<sub>2</sub>: There is no significant relationship between factors that influence user's decision to transform occupied building in the study estate.

H0<sub>3</sub>: The level of involvement of the professionals who manage the study estate has no significant impact in the physical transformation process in the study estates.

H0<sub>4</sub>: There is no significant difference between physical transformation activities and process of one study estate and other.

## RESEARCH DESIGN AND METHOD

Questionnaire and direct field observations form the basis of the research. The questionnaire was divided into two parts: environmental survey and socio –economic survey.

**Environmental survey:** This covered the physical characteristics of buildings in the area. Information were collected on facilities provided within, percentage of derelict and near derelict buildings taking into account such indicators as condition of the

walls, floor, roof, age of buildings and general outlook of the buildings as well as the extent of deterioration. Assessment of these entire variables was made by visual observation.

**Socio-economic Survey:** Questions were asked on the socio economic characteristics of the area. Such information includes size of household and demographic characteristics. Simple random sampling techniques were used in selecting 252 households in the neighbourhood and 246 household heads responded effectively giving 97.61% which is sufficient for valid assessment of the situations under study. The statistical analyses used include descriptive statistics such as percentage and frequency counts. This research employs the use of SURVEY DESIGN.

The research was carried out in government estates that were first constructed in each of the selected towns and states. These states are: Lagos (Ikeja GRA), Oyo state, Ibadan, (old Bodija), Ondo state, Akure (Ijapo). The selected three towns were the state capitals for the selected three states out of six state of Lagos, Oyo, Ogun, Ekiti, Ondo and Osun states of Nigeria that constitute the Southwestern States.

The study targeted occupants (household heads) that transformed and those that did not transformed their buildings. The study was also carried out among professionals in the built environment working in the public institutions responsible for the management of the study estates. Nine public institutions were visited.

Simple Random sampling was used to select houses and streets in the sampled housing estates. Systematic sampling was employed to select the household head on selected streets to be interviewed. Three sets of data were collected for this study.

Data for the research were collected with the use of interview schedules, observations, photo prints, and structured questionnaires administered on 474 transformers, 360 Non-transformers and 87 professionals in charge of housing provisions in nine public institutions, responsible for the management of the study estates.

The interview with structural questionnaire method of Data collection was considered for this study. This minimized bias, response consistency was obtained, it was less time consuming when compared with the interview method.

## RESULT AND DISCUSSION

This section presents the summary of major finding of this research in a way to ensure the objectives of the study are fulfilled. The results are therefore summarized as follows:-

### Socio-economic factors:

#### Occupation

Table 4.1: Occupation of the respondents

Occupation Type	Respondent who Transformed their building		Respondent who did not transformed their buildings	
	Frequency	% of respondents	Frequency	% of respondents
Unemployed	12	2.5	13	3.9
Self employed	270	57.0	137	39.6
Civil/public servant	150	31.6	157	45.4
Others	42	8.9	53	11.2
Total	474	100	360	100

(i) Table 4.1 shows the Majority of those that transformed are self-employed, while those that did not are public servants. This confirms that original occupants (public servants) are being displaced by those who are self employed, who are supposed to have more access to fund. The result of ANOVA (Table 4.2) also support that the majority that transformed were self-employed.

Table 4.2: ANOVA for the various occupation types of the respondents

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Occupation type	9445.887	8	1180.736	25.230	0.000
Error	842.373	18	46.799		
Total	10288.261	26			

### Marital status

There was a preponderance of married persons among the respondents that transformed their building (81.9%) as observed in the table 4.4 For those that did not, majority were single (80.4%) and 10.6% were married. The result of ANOVA (Table 4.5) revealed that only married occupants distinguish differed from other marital status. Indicated that, this is a factor necessary for transformation, since more space are needed for accommodate more household.

Table 4.4: Marital status of the respondents

Status	Respondent who Transformed their building		Respondent who did not transformed their buildings	
	Frequency	% respondents	Frequency	% respondents
Single	56	11.8	287	80.4
Married	388	81.9	38	10.6
Widow	6	1.3	22	6.2
Widower	7	1.5	5	1.4
Divorced	4	0.8	3	0.8
Separated	13	2.7	5	0.6
Total	474	100	360	100

Table 4.5: ANOVA for the distribution of respondents' marital status

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Marital Status	6627.867	5	1325.573	4.855	0.012
Error	3276.393	12	273.033		
Total	9904.260	17			

### Income stratification

The result indicated that the higher the income, the tendency for occupant to transform, their building (see Table 4.6). From the results of the chi-square test, income level of the respondents has a strong associations with the type of building occupied ( $P < 0.05$ ).

Table 4.6: Income stratification of respondents

Income Class	Respondent who Transformed their building		Respondent who did not transformed their buildings	
	Frequency	% respondent	Frequency	% respondent
Low	27	5.7	132	38
Low middle	79	16.7	158	45.5
Upper middle	180	38.0	53	11.5
High	188	39.7	17	4.9
Total	474	100	360	100

Table 4.7: ANOVA for the respondents' percentage distribution into income strata

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Income Class	5720.423	4	1430.106	2.355	0.124
Error	6073.227	10	607.323		
Total	11793.649	14			

### Factors that influenced user's decision to transform occupied buildings

**Source of Money:** Majority of transformers (73.2%) source their money which they used to transform by embarking on self/personal savings (see table below). The table below presented the mean separation of the ANOVA using a Duncan Multiple Range Test (DMRT) distinguishes self saving from other source of money for transformation.

Table 4.14: Source of money for physical transformation

Source of Money	Transformers	
	Frequency	% of respondents
Self/ personal savings	308	73.2
Mortgage borrowing (FMBN)	30	7.1
Commercial banks	30	7.1
Cooperative societies	22	3.6
Family inheritance	6	1.4
Local borrowing	10	2.4
Others	68	5.2
Total	474	100

Table 4.15: Mean Separation for respondents' source of money for transformation

Source of money	Mean (% Respondents)
Self/ personal savings	75.33 <sup>a</sup>
Mortgage borrowing (FMBN)	6.97 <sup>b</sup>
Commercial banks	6.90 <sup>b</sup>
Cooperative societies	4.73 <sup>b</sup>
Family inheritance	1.27 <sup>b</sup>
Local borrowing	4.43 <sup>b</sup>
Others	2.60 <sup>b</sup>

*Means sharing the same superscript in column are not significant*

### Age of transformed building

The table below shows that buildings transformation was carried out where such structures are between 10 and 30 years of age. ANOVA showed that age classes differed across the study area ( $P < 0.5$ ). From the mean separation using DMRT presented in table below, building age class 10 – 20 years was quite distinct from every other class.

Table 4.16: Age of transformed building

Building Age	Transformers	
	Frequency	% of respondents
Below 10yrs	89	19.6
10 – 12yrs	203	44.7
21 – 30yrs	110	24.2
31 – 40yrs	32	7.0
41 – 50yrs	8	1.8
Above 50yrs	32	2.7
Total	474	100

Table 4.17: Mean Separation for respondents distribution to the age of transformed buildings

Building age	Mean of % respondents $\pm$ SE
Below 10	$20.50 \pm 6.29^a$
10 – 20 years	$47.50 \pm 4.8^c$
21 – 30years	$21.23 \pm 7.29^a$
31 – 40years	$6.96 \pm 3.53^{ab}$
41 – 50years	$1.76 \pm 1.11^b$
Above 50years	$2.10 \pm 1.72^b$

*Means sharing the same superscript in column are not significant*

### Reaction of respondents to physical transformation taking place in the neighbourhood

Majority of transformers are of the opinion that the physical transformation activities are providing infrastructures to the neighbourhood (See table below). This is opposing to a view that transformers are creating slums, and that infrastructures that were not provided by government were being provided.

Table 4.24: Reaction to physical transformation in the neighbourhood

Reaction to neighbourhood	Transformers	
	Frequency	% of respondents
Indifferent	189	39.9
Worrisome	37	7.8
Providing infrastructure	234	49.4
Other	14	2.9
Total	474	100



**Home based enterprises (HBES)**

Table 4.27: Home based enterprises

Home Based Enterprises	Transformers	
	Freq	% of respondents
Provision shop and hair dressing/ barbing shop	150	31.6
Provision shop, hairdressing / barbing shop and livestock keeping	83	17.5
Provision, Hairdressing/barbing shop and livestock keeping and tailoring	22	4.6
Provision shop/patient medicine store, stationeries / barbing shop	57	12.0
Shop, stationeries / photocopies and restaurant	66	13.9
Others	96	20.3
Total	474	100

**Other uses for transformed residential buildings**

Apart from residential purpose, the most common use for transformed building is office accommodation (47.7%) (see Table 4.28). This indicated inadequacy of the layout plan of the study estates. The ANOVA and DMRT table are shown below. It was shown that there is sig. diff ( $P < 0.05$ ).

Table 4.28: Other uses for transformed building

Other uses for transformed building	Transformers	
	Frequency	% of respondents
Office Accommodation	226	47.7
Warehouse	27	5.7
Place of worship	41	8.6
School accommodation	33	7.0
Hotel accommodation	24	5.1
Shopping	52	11.0
Worship	25	5.3
Total	474	100

Table 4.26: ANOVA for the respondents' view to other uses for transformed buildings

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Building uses	3676.712	7	525.245	13.057	0.000
Error	643.647	16	40.228		
Total	4320.358	23			

**Transformation problems**

Delay of approval of drawings and lack of cash flow from the major problems encountered during transformation process. The result of the analysis of variance revealed a significant variation in the respondents' distribution to the identified transformation related problems.

Table 4.38: Transformation problems

Transformation problems	Transformers	
	Frequency	% of respondents
Lack of cash flow	98	20.7
Poor supervision of work	55	11.6
Use of low quality materials	20	4.2
Delay of approval of drawings	188	39.7
Denial of approval	19	4.0
Harassment of government officials	56	11.8
Others	38	8.0
Total	474	100

Table 4.39: ANOVA for the respondents' distribution to the problems associated to transformation

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Transformation Problems	2913.99	6	485.67	9.03	0.00
Error	752.65	14	53.76		
Total	3666.65	20			

### Reasons for transformation

Main reason why occupants embarked on transformation is to generate more income for the family-follow by the need to accommodate more people. The need for providing shopping needs and to effect aesthetic change ranked third and fourth.

Table 4.51: Reasons for transformation

Reason for transformation	Ikeja		Bodija		Ijapo	
	Freq	%	Freq	%	Freq	%
More income	51	38.3	87	43.3	59	42.1
Accommodate more people	20	15.0	34	16.9	42	30.0
Employment nearer	19	14.3	22	10.9	6	4.3
Satisfying shopping need	23	17.3	24	11.9	18	12.9
Effect Aesthetic change	20	15.0	28	13.9	11	7.9
Others	-	-	6	3.0	4	2.9
Total	133	100	201	100	140	100

Study estate	Designing transformed building	Construction of transformed building	Mgt of transformed buildings	Qty	Finding solution to problem encountered	Writing aesthetic standard	Total
Ikeja GRA	48	27	8	6	25	19	133
Old Bodija housing estate	69	53	20	10	22	27	201
Ijapo housing estate	29	35	13	9	30	24	140
Total	146	115	41	25	77	70	474
Freq	30.80	24.32	8.32	5.20	16.24	14.76	100

### Level of involvement of professionals in public institution responsible for the management of the study estates, in physical transformation process

One out of every four carried out construction of transformed buildings, while one out of every three carried out design of transformed building.

### Comparative analysis of transformed buildings in three study estates human needs provided

Physiological and safety/security are the most valued of all human need provision. This confirmed Maslow (1970) growth motivation principle in the hierarchy of needs. Ikeja GRA scored 84.9% Bodija 63.25% and Ijapo 68%. This plays a major role in the decision on whether to transform or not.

Table 4.34: Human needs provision

Human Need Provision	Ikeja		Bodija		Ijapo	
	Freq	%	Freq	%	Freq	%
Physiological (Comfortable Conditions)	66	49.6	56	30.8	51	36.4
Safety and Security	47	35.3	59	32.45	47	33.6
Attention and belonging	2	1.5	14	14.7	10	7.1
Esteem (pride of social status etc)	5	3.8	43	23.66	19	13.6
Self actualization (self development and success)	13	9.8	9.8	5.39	13	9.3
Total	133	100	181.8	100	140	100

### Effects on the environment

Respondents in Ikeja and Ijapo estates graded the effect to be middle, while respondents in old Bodija submitted that the transformation activities were of no effect on the environment. Respondents of the three estates are of the opinion that transformation activities have NOT turned their neighbourhood into a slum, and generally had positive impact on the estate's environment.

Table 4.41: Effect on environment

Effect on Environment	Ikeja		Bodija		Ijapo	
	Freq	%	Freq	%	Freq	%
None	15	11.3	76	37.8	38	27.1
Low	23	17.3	13	6.5	24	17.1
Middle	54	40.6	75	37.3	68	48.6
High	4.1	30.8	37	18.4	10	7.1
Total	133	100	201	100	140	100

Table 4.42: Transformers changing neighbourhood to a slum?

Transformers changing neighbourhood to a SLUM	Ikeja		Bodija		Ijapo	
	Freq	%	Freq	%	Freq	%
Yes	19	14.3	35	17.4	9	6.4
No	114	85.7	166	82.6	131	93.6
Total	133	100	201	100	140	100

### Mode of Transformation

Preferred mode in both Ikeja and Ijapo Housing Estates is Renovation while preferred mode at Old Bodija is rehabilitation.

Table 4.47: Mode of transformation

Preferred changes during transformation	Ikeja		Bodija		Ijapo	
	Freq	%	Freq	%	Freq	%
Demolishing and Rebuilding	32	24	46	22.9	285	20.0
Renovating	68	51.1	47	23.4	64	45.7
Rehabilitation	22	16.5	54	26.9	39	27.9
Repainting only	11	8.3	39	19.4		
Others	-	-	15	7.5		
Total	133	100	201	100	140	100

### Problems Encountered

Ikeja and Old Bodija identified the same problem of delay of approval of drawings by government officials, while Ijapo estate identified lack of adequate cash flow. For three estates one –third ( $\frac{1}{3}$ ) of the problems encountered were in delay of approvals

Table 4.50: Problems encountered before and during transformation process

Problems Encountered before and during transformation process	Ikeja		Bodija		Ijapo	
	Freq	%	Freq	%	Freq	%
Lack of adequate cash flow	13	9.8	33	16.4	52	37.1
Poor supervision of work	16	12.0	14	7.0	25	17.9
Use of low quantity of materials	9	6.8	8	4.0	3	2.1
Delay of approval of drawings	62	46.6	79	39.3	47	33.6
Denial of approval	8	6.0	9	4.5	2	1.4
Harassment of govt official	22	16.5	27	13.4	7	5.0
Others	3	2.3	31	15.4	4	2.9
Total	133	100	201	100	140	100

## CONCLUSIONS AND RECOMMENDATIONS

One of the most intractable socio-economic problems facing the Nigerian nation today is acute shortage of comfortable and affordable housing for the people. This research has been able to highlight on various factors that determine user's decision to transform already occupied buildings; made a comparison of transformation activities and processes among the study estates; and identified the significant prediction variables influencing building transformation. The study has found that people embarked on building transformation to provide those infrastructures that were not provided by government. Income level of occupants was the most important determinant variable associated with transformation process. It has identified delay of approval of plan and lack of cash flow as problem encountered in the transformation process. It has further established that the physical features of the existing house affect housing transformation decision rather than household's income or composition. The need to provide transformers with credit facilities, accommodate extension as phase construction, seek proper approval for proposals, provision of service delivery

enterprises on the study estates are some of the recommendations proposed in this research.

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# AN EXPLORATORY STUDY OF THE CONTEXTUAL MEANING AND CONSEQUENCES OF EMPOWERMENT IN PROJECT TEAMS

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Empowerment means different things to different individuals. The factors that engender feelings of empowerment and the consequences that ensue are thus multifarious. Using the Critical Incident Technique (CIT) in semi-structured interviews with project participants in Hong Kong, the contextual meaning and consequences of empowerment are explored. Two broad categories of meanings were ascribed to the concept “empowerment” and related to “what individuals or teams feel or experience” and “what organisations or leaders do”, confirming the extant literature’s dichotomous conceptualisation of empowerment into the structural and psychological perspectives. Positive and negative consequences of empowerment and disempowerment were evident. The need to capture the different individual conceptualisations of empowerment in the implementation of empowerment initiatives is shown and that a contextual fit is essential for empowerment to take place.

Keywords: Critical Incident Technique, empowerment, Hong Kong, project team.

## INTRODUCTION

The construction industry exhibits certain characteristics that make it an ideal climate for the empowerment of employees (Greasley et al., 2005). These characteristics include; its project/site-based nature, complexity, uncertainty, poor communication (i.e. timing, extent and content), inadequate co-ordination (i.e. of organisations and activities) and inadequate integration (i.e. of tasks, organisations and personnel). Indeed, empowered working is inherent in the way projects are run as autonomous profit centres (Beardsworth et al., 1988, Loosemore et al., 2003, Walker, 2002). Empowerment as a concept however remains diffuse and poorly defined (Dainty et al., 2002), widely misunderstood (Rudolph and Peluchette, 1993) and predisposed to conflicting interpretations in both academic and management practice discourse. As Simon (1990) points out, that empowerment is a concept that confuses even as it inspires. The lack of clarity as to what empowerment entails and how it manifests itself is further compounded by its apparent neglect (i.e. taken for granted), making it an empty rhetoric or a fortunate by-product (Psoinos and Smithson, 2002).

A concomitant problem in most empowerment research therefore is that the empowerment construct is hardly directly examined or clearly defined. Within the construction industry context in particular, empowerment research is still piecemeal

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and fragmented, often characterised by exploratory one-off case studies. Findings regarding how empowerment manifests as well as how it impacts work outcomes are either unavailable or unreliable. Noteworthy efforts in this direction are however beginning to emerge (e.g. Greasley et al., 2008, Greasley et al., 2005, Liu et al., 2007). In support of this growing effort, this study set out to explore the contextual meaning of empowerment in project settings and to examine the consequences attributed to empowerment.

Within the extant literature, empowerment is distinctively conceptualised as a structural concept and as a psychological concept. As a structural concept empowerment is deeply rooted in job design and is deemed to occur through objective and often formal organisational changes that grant individuals greater latitude to make decisions and exert influence regarding their work (Eylon and Bamberger, 2000, Ford and Fottler, 1995, Liden and Arad, 1996). Eylon and Bamberger (2000) describe structural empowerment as “empowering acts/practices” while Seibert et al (2004) describe it as “empowerment climate” which arises from the purposeful manipulation of structural and contextual factors of the work environment, its policies and practices. Consistent with this view, opportunity, power (formal and informal) sources, access to information, support, resources and responsibility have been identified as central explanatory dimensions of an empowering organisational/work-unit environment (Bowen and Lawler, 1995, Eylon and Bamberger, 2000, Kanter, 1977). The psychological perspective on the other hand proposes that empowerment is a constellation of experienced cognitions. According to Spreitzer and Quinn (2001, p. 13-14) psychologically empowered individuals “see themselves as having freedom and discretion (self-determination), as having a personal connection to the organisation (meaning), as confident about their abilities (competence), and as able to make a difference in the system in which they are embedded (impact)”. These four dimensions therefore combine additively to create an overall gestalt of psychological empowerment so that lack of any single dimension will deflate, but not completely eliminate, the overall degree of empowerment (Spreitzer, 1995a).

While the extant literature has distinguished the two facets of empowerment as outlined above, it is unknown whether in project settings what empowerment entails or how it manifests itself will be consistent with this theoretical view. Indeed, considering that these conceptualisations have been developed from a mainly western perspective, empowerment may mean different things in a Chinese context. Examining how empowerment manifests itself among project participants in a mainly Chinese context therefore has both theoretical and practical significance. To extend empowerment theory and encourage empirical enquiry, the meaning of empowerment as perceived by project participants in their work role in Hong Kong and the consequences that can arise are explored. The study was guided by two broad propositions:

*P1: Empowerment means different things to different individuals and,*

*P2: The empowerment of individuals and teams in project settings has consequences.*

In the sections that follow, the research method for the study is outlined followed by the discussion of the findings arising. We conclude by outlining the implications of the findings for research and practice.



## RESEARCH METHOD

The interpretive and exploratory focus of this study favours a qualitative approach and the Critical Incident Technique (CIT) was identified as a suitable method to employ. CIT was originally developed in the 1950s by John Flanagan and his colleagues through various studies at the Aviation Psychology Program of the US Army-Air Forces. Essentially, CIT consists of a set of procedures that enable the direct observations of human behaviour or the elicitation of experiences referred to as 'incidents'. An incident in this regard refers to "any observable human activity that is sufficiently complete in itself to permit inferences and predictions to be made about the person performing the act" (Flanagan, 1954, p. 327). The analysis of critical incidents so gathered allows for the emergence, rather than the imposition of an evaluative schema and focuses on the events and dimensions of the respondent's experiences that are most salient, memorable, and most likely to be retold to others (Ruben, 1993). The practicality of CIT in construction research has been demonstrated in several studies (e.g. De Saram *et al.*, 2004, Kaulio, 2008). Its use here therefore arises from its appropriateness for the problem of study and the demonstrated reliability, validity and practicality, especially in construction specific studies.

### Design of interview

A semi-structured face-to-face interview mode was adopted as it afforded greater flexibility and the opportunity to probe for clarifications and deeper insight. Although retrospective empowering and disempowering experiences were solicited, the premise was that recollections were less likely to be distorted due to their 'critical' or 'extreme' nature and the reference to a relatively short time-frame (i.e. within last 6 months) and discrete events (Flanagan, 1954). The respondent's conceptualisation of empowerment was sought through the elicitation of incidents using a 4-part question format;

- a. What does empowerment mean to you in your work role?
- b. The critical incident identifier statement (Campbell and Martinko, 1998), which read, "*Think of a personal experience during a current or recent project (within the last 6 months) when you felt particularly empowered or disempowered in the performance of your work role*";
- c. The grand tour statement (McCracken, 1988), which read, "*Please describe this experience in as much detail as you can remember*"; and,
- d. Planned prompts and probes as necessary (McCracken, 1988).

The above approach was repeated to elicit individual and team experiences.

### Sample and responses

Sample size in CIT studies is determined by the number of critical incidents required to achieve adequate coverage of the subject of study and this in turn also depends on the complexity of the problem under investigation (Flanagan, 1954). For most purposes, however, a minimum of hundred incidents are considered sufficient (Flanagan, 1954) or incidents are collected until redundancy occurs (Woolsey, 1986). Thirty respondents and a minimum of 4 critical incidents per respondent were targeted (i.e. a pair-wise design of one each of an empowering and a disempowering personal experience as well as one each of an empowering or disempowering team experience). A purposive sampling technique was employed, to maximize quality of information. Ten respondents each from contractor, consultant and client organisations were selected. Typical targets were site/project managers, engineers, quantity surveyors,

designers/architects, etc. This diversity of respondents was to ensure that incidents collected are comprehensive in their coverage of diverse perspectives represented in project settings (c.f. Flanagan, 1954). The respondents comprise 5 females and 25 males and their average tenure in the industry is 9 years. All the respondents are Chinese and have a Bachelors degree or higher.

### Analysis strategy

No *a priori* framework was specified in analysing the responses regarding the meaning of empowerment and how empowerment and disempowerment manifest. This was consistent with allowing the different meanings that different individuals ascribe to empowerment to emerge. Thus, category formation was employed initially to explore the data and to subsequently establish if any pattern was discernable among the themes. The classification was facilitated by employing the QSR NVivo 8.0 software for qualitative data analysis. This was used to code (i.e. assign themes to describe phrases or sentences), organize and link (i.e. group and merge) the emergent antecedents under each frame of reference. In the following section, we present the results of the analysis, first about the meaning respondents ascribed to the empowerment and then the emergent consequences of empowerment and disempowerment.

## FINDINGS AND DISCUSSIONS

### What does empowerment mean to project participants?

In response to the question “*what does the empowerment mean to you in your work role?*”, the responses were unsurprisingly varied. As expected, empowerment meant different things to different people. To some it was about respect;

“...other team members are now more respectful towards me, since I have the right to check and endorse their submissions” [Project Engineer, Client].

To others it was about responsibility and authority;

“ [I am] given responsibility and authority to make all necessary decisions related to delegation, control, problem solving, actions necessary for efficient management of the process with the consultants, client and hotel operator, without the need to refer to higher authority for making decisions” [Project Manager, Contractor].

Yet, to others, empowerment was also about how power and responsibility is defined and distributed in the organisation. Two broad categories were however apparent from the different meanings ascribed to the concept ‘empowerment’; *what individuals or teams feel or experience* and *what organisations or leaders do*. We depict the identified sub-themes under each category in Figure 1 below. Incidentally, this dichotomy of meanings mirrors the distinction between *structural empowerment* (*empowerment climate*) and *psychological empowerment* in the extant literature (c.f. Conger and Kanungo, 1988, Kanter, 1977, 1993, Liden and Arad, 1996, Spreitzer, 1995a, Spreitzer, 1996, Spreitzer, 1997, Thomas and Velthouse, 1990). More specifically, seven themes as depicted in Figure 1; being independent, having flexibility, having decision-making authority, having power, self-control of outcomes, processes and resources relate to the self-determination dimension of psychological empowerment. Being motivated, respected by colleagues and a sense of being trusted and recognized also correspond to the meaning dimension. The self-confidence and sense of responsibility themes may be interpreted as being aligned with the competence dimension. Lastly, only one theme, having influence over organizational

procedures, reflects the impact dimension of psychological empowerment. Evidently, respondents tended to associate feelings of empowerment with self-determination and meaningfulness as evident by the number of themes in these categories compared with those related to competence and impact. The greater emphasis on empowerment as self-determination which is more aligned with power may not be surprising given the high power-distance context of the study (c.f. Hofstede, 1980) in which social hierarchy, order and certainty reign supreme. Many respondents may therefore have perceived their jobs as lacking self-determination and thus, view power redistribution as a means of enhancing their sense of empowerment. The themes related to what organisations or leaders do, and thus aligned with the structural perspective of empowerment comprised; *definition and distribution of responsibility, delegation, devolution of power; level of direct supervision or interference, provision of opportunity, organisational support, resource availability and distribution of responsibility*. These themes mirror the dimensions of empowerment climate proposed by both Kanter (1977, 1993) and Seibert *et al* (2004). The themes in this category particularly reflect acts that are more amenable to manipulation by leaders through organisational policies.

Taken together, the manifestation of empowerment is largely consistent with conceptual expectation. Greasley *et al* (2005) also identified similar themes relating to what empowerment meant to senior industrialists in the Netherlands. However, in a recent study by Greasley *et al* (2008) in the UK, non-managerial employees appeared not to recognise the term empowerment or were unable to ascribe direct meanings to it. Spreitzer (1997) also found in an earlier study that individuals had difficulties defining empowerment but had little problems describing personal episodes of empowerment. All the studies however converge on one central finding that, the term empowerment means different things to different individuals.

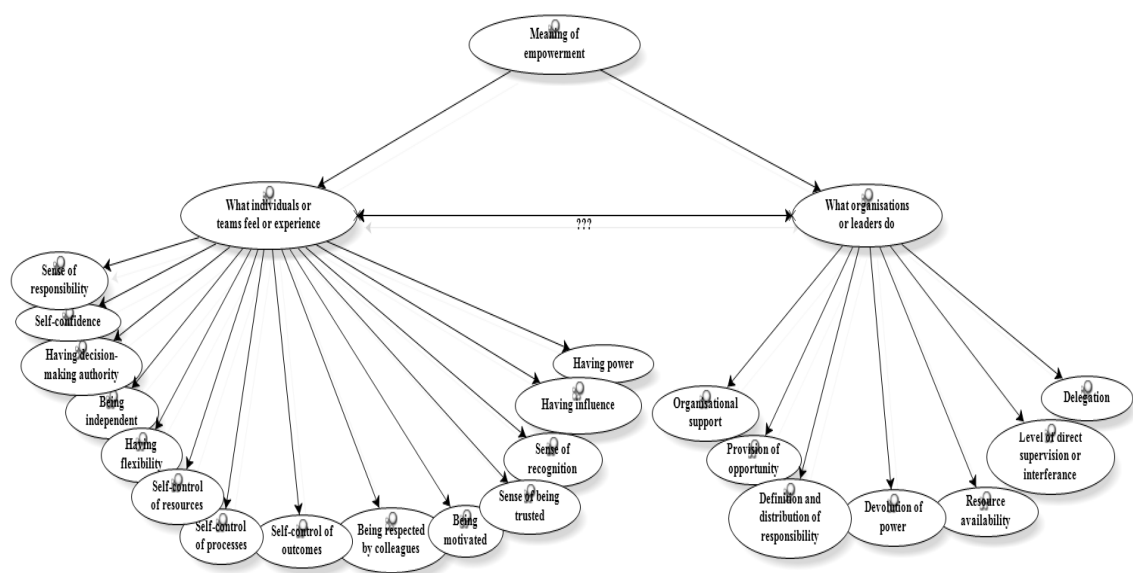


Figure 1: What empowerment means to project participants (QSR NVivo Output)

### Consequences of empowerment and disempowerment

Several themes relating to perceived consequences of empowerment or disempowerment were apparent from the critical incidents described. The themes related to consequences are shown in Figure 2. Four positive consequences were

attributed to empowerment; project success, job satisfaction, teamwork, savings in time and rapid decision-making. Interestingly, poor work quality also emerged as a possible outcome of empowerment. Poor quality of work was specifically linked to lack of experience;

*“the quality of work may be reduced due to less experience in doing a particular task, for example, submissions procedures in this case”* [Site Agent, Contractor]

This reinforces the importance of making sure that only capable and experienced employees are empowered for positive outcomes. Regarding project success, several experiences highlighted the fact that empowerment can lead to top management establishing a clear direction for the project and allowing the project team to decide what operational tasks are required to achieve the overall aims of the project. By doing this, top managers are freed from the daily site operations so that they can concentrate on more strategic issues. The experience of a senior engineer is illustrative of this view;

*“as the team was empowered to handle the individual design issues in our discipline, the project manager did not need to take care of the discipline design issues. This saved time for other management work that can contribute more to the success of the project”* [Senior Engineer, Consultant].

Teamwork was also perceived as an outcome of empowerment;

*“....following this [an empowering experience], there was great teamwork spirit distributed all over our team. All team members were willing to put in extra effort to complete their tasks and leave together as a team”* [Quantity Surveyor, Contractor].

This is a particularly interesting finding in project settings that are so dependent on teamwork for task accomplishment. Yet, ‘real teamwork’ has eluded many project organisations as initiatives such as partnering have often failed to achieve the needed change as a result of the lack of empowerment of key project participants (Ng et al., 2002). Empowerment may therefore hold a key to engendering real teamwork in project settings. Indeed, in a related empirical study, Tuuli and Rowlinson (2009) found empowering work climate and team psychological empowerment positively and significantly related to teamwork.

Empowerment was also viewed as engendering job satisfaction, time saving and rapid decision-making as a result of less hierarchies, reduction of red-tape procedures, greater direct involvement and engagement of employees. These outcomes have also been identified in other empirical studies. In particular, empowerment has consistently been found to be positively and significantly related to job satisfaction (c.f. Aryee and Chen, 2006, Koberg et al., 1999, Seibert et al., 2004, Spreitzer, 1997, Thomas and Tymon, 1994) and productivity (c.f. Chang and Liu, 2008, Kirkman and Rosen, 1999).

Three outcomes associated with disempowerment were also recurrent; slow work pace, blame from others for inaction and a sense of withdrawal. The slow work pace was linked to unavailability of resources and the lack of decision making authority. These invariably led to blame from others for inaction. This view is illustrated by the response of a consultant’s resident engineer;

*“If I had been empowered to handle the redesign, there will be less complaints about our slow response to the client's requests.....and the progress will be smooth as the redesign work would have been completed at an earlier time”* [Resident Engineer, Consultant]

The experiences also show that project participants react to disempowerment with a sense of withdrawal or resignation.

*“In a recent project when the endorsement of materials was done by the senior supervisor and I had almost no authority, I paid no attention to the details of the materials submitted and didn’t even bother to check them either.”* [Senior Engineer, Contractor]

This finding is also in accord with that of Aryee and Chen (2006) who found that empowerment can ignite excitement about one’s work and therefore result in reduction in psychological withdrawal behaviours.

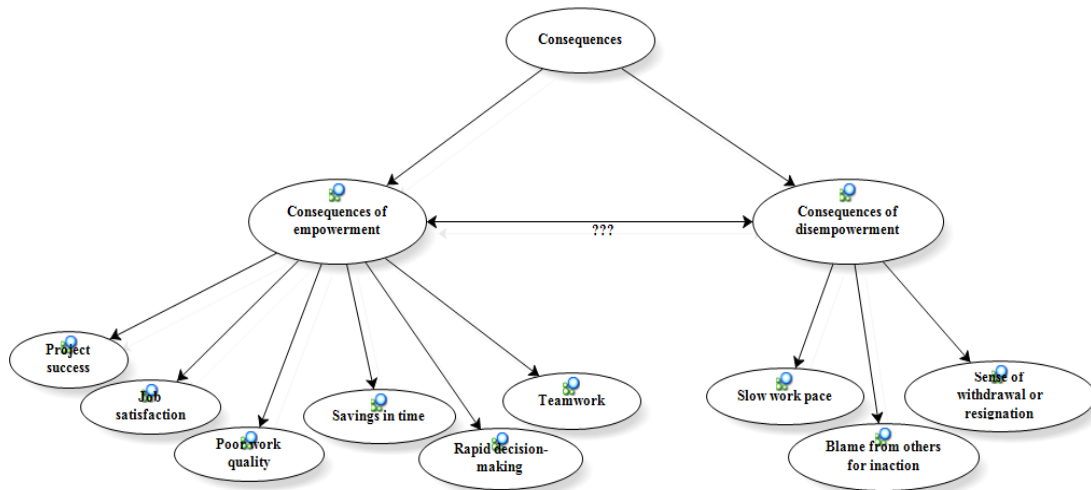


Figure 2: Consequences of empowerment and disempowerment (QSR NVivo Output)

## CONCLUSIONS

Empowerment means different things to different individuals. This stems from the different socialisation and the varied interpretations individuals make regarding actions, policies and practices within their work environment. Indeed, as Spreitzer and Doneson (2008) point out, in some situations power, knowledge, information and resources are shared, yet employees still evince disempowerment, and in other situations all the objective features of an empowering work climate are absent, yet employees feel and act empowered. Thus, the finding that employees ascribe different meanings to empowerment which were classified into two broad categories, reiterates the dual role of the organisations or leaders and the employees themselves in the success of any empowerment process. This also reinforces earlier conclusions in a quantitative study by Tuuli and Rowlinson (2009) that it is only by simultaneously creating an empowering work climate that engenders feeling of empowerment that the full benefits of any empowerment intervention can be achieved in project settings.

Interestingly, we found that empowerment is not associated with only positive consequences but can be counterproductive if the individual and organisational circumstances are not fully examined and properly built into the empowerment process. Thus, a contextual fit must be targeted. Empowerment however has the potential to engender job satisfaction, teamwork and productivity that have eluded many project organisations. Organisations must however guard against disempowerment as it can lead to alienation of employees, reduce productivity and

even engender the creation of a blame culture as employees increasingly become helpless.

This study advances empowerment theory in several fronts. First, it provides evidence of convergent validity in support of the distinctiveness of the structural and psychological perspectives of empowerment. Given the Chinese as well as construction project context of the study, external validity is also evident. Methodologically, this study adds to the work of De Saram *et al* (2004) and Wong (1999) in demonstrating the practicality of the CIT in construction specific research.

This study however has several limitations which deserve highlighting. First, the respondents in this study were purposively selected partly because of their willingness to share their experiences. It is therefore plausible that they demonstrated higher levels of awareness of their level of empowerment or disempowerment and hence the conditions that perpetuate such feelings. A related limitation is the possibility of self-serving attribution bias, which manifests itself in the tendency to take credit for successes and blame others for failure (Bradley, 1978, Miller and Ross, 1975). By not asking respondents to describe their perceived level of empowerment at the time of the experiences, we were unable to test whether respondents less empowered made external attributions of their disempowerment or whether those more empowered made internal attributions regarding their empowerment.

By employing the CIT, the study also inherited its several limitations. For example, the possibility that respondents misunderstood the phenomena they were required to describe is high. In particular, the reliance on recollection of incidents introduces a bias towards more recent incidents. In this study incidents were limited to only those that occurred within the last 6 months. A further potential limitation for this study and studies using interviews is the problem of verbal skills and the amount of verbalisation respondents are capable of within the interview period. This is particularly pronounced in this study where the interviews were conducted in English which is not the primary language of the respondents. The requirement of respondents to recall incidents and describe them in as much detail as possible may have overburdened some respondents. While the higher educational level of respondents was expected to attenuate the effect of verbal skills, we still checked its effect by comparing the frequencies of the identified themes by respondents versus by incidents (c.f. Campbell and Martinko, 1998) and found no significant differences in the proportions. However, it was clear that respondents who provided more incidents or more detailed descriptions were more likely to generate more themes, thus having a greater influence on the results.

These limitations however highlight avenues that future research might pursue. Replications of this research with further improvements in the research design to address the limitations outlined above will advance research and practice in this area of research. Finally, this study has provided a crucial first step in further clarifying how project participants perceive empowerment and the consequences that can ensue from empowerment in project settings and should therefore contribute to a better understanding and design of empowerment initiatives in construction project organisations.

## ACKNOWLEDGEMENTS

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# AN INVESTIGATION INTO THE USE OF UNAPPROVED DRAWINGS IN THE CONSTRUCTION INDUSTRY IN GHANA

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The use of unapproved building drawings has resulted in haphazard development of settlement areas. Buildings are sometimes poorly sited in waterways and spaces reserved for public facilities. On the other hand approved drawings guide residential developers to put up building structures at approved spaces. This ensures that building structures are developed orderly and sited in the right spaces, to achieve efficient social and economic infrastructure needs; the goal was to establish the extent of the use of unapproved building drawings on the built environment in four selected areas in Kumasi. Thus the extent of the problem of people not using development and building permits in the selected areas was established. Face-to-face interviews were conducted with professionals in the Academia, statutory bodies and industry. That apart, collection of information from journals, textbooks was carried. Structured - questionnaires were administered to personnel of Kumasi Metropolitan Assembly, Inspectorate Department, private developers and builders in the selected areas. It was found out that about 90% of the buildings were put up without development and building permit. The factors contributing to the use of unapproved drawings in the selected areas in the development of building structures were also found out to be the processing time of permit, re-entry, location, Nearness to development, guidance of building inspectors, nearness to relations, and non-involvement of professionals

Keywords: building permit, developer, settlement, unapproved drawing.

## INTRODUCTION

It is a notable fact that many developments are taking place without full authorisation from the statutory bodies. As such most of the buildings being developed on new construction sites in Ghana have the inscription “Stop work Produce permit.” These are an indication that many building projects go on all over the place without the use of approved drawings. Evidence is the situation at Ashaiman in Accra where 250 buildings were earmarked for demolishing (Daily Graphic, April, 19, 2010) Another, instance was when Team Development Corporation (TDC) had to control unauthorized structures to avoid unauthorized development practices (Daily Graphic, September, 8, 2008) This has resulted in haphazard sitting of building structures within the metropolis and other urban centres all over the country. This is becoming a national headache and the former Minister for Works and Housing had a cause to lament bitterly in his press release, sometime ago. The release warned that if serious action was not taken to reverse the trend quickly, Accra and its surrounding areas, for that matter, may experience serious flooding problems due to the continued flouting of statutory regulations with impunity by developers, who continue to site building structures in waterways (Daily Graphic, June, 29, 2001). The release further had it that

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about 60% to 70% residential structures were illegal because their owners fail to obtain building permits from the appropriate authorities before the commencement of work. The Kumasi Metropolis appears to be in a more serious situation as compared to Accra. This deplorable development that the country is going through could be attributed to the use of unapproved drawings prior to the start of development projects. There is haphazard development of building structures in reserved spaces, waterways and low lying areas or marshy areas without development and building permits. The situation has seriously caused flooding at some places, made many completed and uncompleted buildings be abandoned caused land litigation to be on the increase and has created difficulties in the use of the street address system in the country.

The aim of this research was to establish the extent of the usage of unapproved drawings on the built environment in the Kumasi Metropolis in Ghana. The objectives were to investigate the extent to which people built without development and building permits. By hypothesis testing, I validated the assertion that most developers build without building permits and approved drawings. Also I carried out hypothesis test to find out whether most developers use drawings from qualified architects for construction of their buildings or not. The factors that contribute to the use of unapproved drawings in the development of buildings in the private sector were also identified

## LITERATURE REVIEW

For clarity and understanding of the type of drawings necessary to be approved for the construction of buildings an attempt has been made to define a few necessary for this work.

### Working Drawings

Working drawings “are detailed plans, elevations and sections drawn to suitable scales, which indicate the position and form of the whole building and its components together with information about the proposed site”. (Grundy 1989), its breakdown is as follows: a) *Location drawings*; b) *Component drawings*; and c) *Assembly drawings*.

**Location drawings** further include: a) *Block plan* - used to identify the site in relation to the locality; b) *Site plan* - used to position the proposed building on site together with information on proposed road, drainage and service layouts and other site information such as levels and strata; and c) *Location plans* - used to position the various areas within the building and to locate the elements and components.

It is clear from the above definition that the block plan of the location drawings is for identification of the site in relation to a locality in U.K. These are however properly called SITE PLANS in Ghana. Similarly, the Site Plans which are for the positioning of a proposed building on sites together with information on proposed roads, drainage, service layouts and other site information such as levels and strata details are referred to as BLOCK PLANS. The Location Plans are very useful as they ensure proper utilization of available space within buildings.

**Component drawings** show the basic sizes and reference system of standard component and also they are indication information necessary for the manufacture of component; they ensure minimum wastage, safety, security and economical use of materials.

**Assembly drawings** provide details of junction between buildings/engineering elements and ensure safety, security and pleasant appearance. They also increase stability throughout the life span of the building structures.

### **The registration of lands in Kumasi**

The responsibility of the administration of state lands has changed hands over the years. All the same, the provisions of the Administration (Ashanti) Ordinance of 1902 under which they originated is still the same. ‘Under section 23 of the Kumasi Lands Ordinance of 1943, registers were established for the purpose of title registration. In 1962 the Land Administration Act (Act 123) was passed to ensure the continuity of the procedures and schemes of title registration”.

Area, and those registers and key maps relating to such land, shall be transferred to and kept by the Chief registrar’. (Agbosu 1975). Administration of stool lands was trusted to the Land Department. The constitution prescribed that ‘consent and concurrence.’ of the Head of state had to be sought for in any transfer. Through these laws, the government admitted that they had no direct control of land although they tried to achieve control of distribution of land. Land acquisition in Kumasi for residential purposes therefore falls into two clear categories; either stool land or state government land. In either case, prospective developers are obliged to go through the required legal procedures laid down to acquire the right title to land to undertake their project. However, prolonged land litigations sometimes delay processing of such documents. The rush by some prospective developers in their bid to avoid possible encroachment has invariably led to the use of unapproved drawings and dotting of illegal structures at various places in the Kumasi Metropolis.

### **Procedure for approval of drawings**

The appropriate authorities including the Town and Country Planning Department (TCP) and the Kumasi Metropolitan Assembly (K.M.A) expect the private prospective developer’s drawing to be presented first, at the Town and Country Planning department; and second, finally exit from the Kumasi Metropolitan Assembly (K.M.A.) Inspectorate Division.

The prospective developer (client) is initially issued a development permit from the Town and Country Planning Department (T.C.P.D.), indicating the satisfaction and the recommendation of drawing documents for an issuance of building permits by the Kumasi Metropolitan (K.M.A.). As such, when buildings are constructed with drawings which have building permits issued to cover them, they are building projects which are executed not with unapproved drawings. This means that the buildings so constructed will be out of the bracket of buildings constructed illegally and conforming to the use of unapproved drawings.

### **Legal regulation for the issuance of building permits**

From the National Building Regulation 1996, it is on record that “in exercise of the powers conferred on the Minister responsible for Works and Housing by section 63 of the Local Government Act 1993 (Act 462), and in consultation with the Minister responsible for Local Government those Regulations are made this 27<sup>th</sup> day of September, 1996”.

“The part 1 of the regulation is for the application of Regulation and Building plans, sub section 2, states that “Any person who intends to

- a. erect any building,
- b. make any structural alteration to any building or
- c. execute any works or installing fittings in connection with any building shall apply” in Town and Country Planning (T.C.P). Form No. I specified in Part I of schedule I to these Regulations to the District Planning Authority of the District where the building structure or works is or is intended to be and shall submit in duplicate the relevant plans with the form.

### **Title to land**

According to National Building Regulation 1996, “An applicant under regulation 2 shall satisfy the District Planning Authority that he has good title to the land relevant to the plans. No approval shall be granted to any applicant who does not have a good title to the land, and, for the purposes of this regulation, good title shall be in accordance with a certificate issued by the chief Registrar of Land Titles or any other agency so authorized”

### **Building permit**

Further National Building Regulation, 1996, 7 (I) The District Planning Authority to which plans have been submitted may in the exercise of its powers under section 64 (I) of the Local Government Act, 1993 (Act 462), grant the building permit in Form B specified in schedule I Part III to these Regulations and may attach to the permit any conditions with respect to the proposed building or work that is not inconsistent with these Regulations including the condition that the applicant shall submit.

Furthermore, information or details as may be required by the District Planning Authority from time to time as the building or work progresses.

(2) Without prejudice to sub-regulation, (1) of this regulation, the District Planning Authority may specify in a building permit the time within which the work authorized in the permit should be commenced.

(3) The period of the validity of a building permit shall ordinarily be five years, except that if the work authorized in the permit is not completed within the time stipulated, the District Planning Authority may extend the period on application by the applicant or his agent who must be a person in the building design profession.

(4) Any building or work carried on after the date of expiry of a building permit and before an application to extend the period of validity has been approved is a contravention of these Regulations.

(5) A District Planning Authority may refuse to issue a building permit if the applicant has failed to complete any building work authorized by a building permit or other approval previously granted to him.

### **Development permit application**

The acquisition of land mostly from the traditional system of land distribution is the initial requirement for a development permit. The prospective developer (applicant) presents his application to Kumasi Planning Committee (K.P.C.). The committee’s secretary checks whether all the necessary information is made available and send; it to the Town and Country Planning Department. The application is checked again for the information provided. The applicant then signs the application form if all the necessary information is supplied, including a site plan which makes it possible to identify the plot of land on the ground. A fee depending on the size of the building is

paid to TCPD. Higher buildings attract higher fees. Below are some basic rates for processing the document.

A single – storey building -GH¢30.00 Residential

A two – storey building -GH¢60.00 Residential

A three- storey building -GH¢90.00 Residential

The level of the fees is stated in a bye-law. After the payment of the fees, the document including the site plan is signed and the application forwarded to Lands Commission.

### **Building permit application**

The next action after obtaining the development permit is to apply for a Building Permit which attracts a fee of 5/8% (0.625%) of the value of the building for which a permit is sought. This is the responsibility of the Metropolitan Engineer's Department (MED) and not that of the Town and Country Planning Department (TCPD). The prospective developer (applicant) has to provide building drawings (working drawings) according to which the building has to be built. Depending on these building drawings the level of the statutory fees is determined. As stated earlier, the fees charge are related to the size of the building, the floor area and location. The MED has to inform the applicant about this level after which the fee can be paid.

Subsequently, the Metropolitan Engineer must sign after which the chairman of the K.P.C. also signs. It is only then that the building permit is issued. This is to enable the authority to check whether the applicant has the right title to the land. When the confirmation of the title is given, then the application is returned to Kumasi Planning Committee (K.P.C) for approval. It can be approved with or without conditions and it can be refused or deferred for further investigation.

The long procedure can take months and sometimes years to be completed. The nature of the procedure leaves opportunities for richer people to speed up the process by paying bribes. After the development permit is issued, the developer can go ahead to develop the land according to the approved plans. This is not enough, however, since before any building can be put up, a building permit is also required" (Van Donkelaar and Van der Laan 1994).

Table 1.0 - Time taken to obtain permit

Duration	Frequency	Percentage
01 -06 Months	5	9
07-12 Months	14	25
01 - 02 Years	28	50
03 - 04 Years	7	13
05 and More Year	2	3
Total	56	100

Source: Van Donkelaar and Van der Laan (1994)

The situation stated above, therefore, encourages the use of unapproved drawings by the prospective developers in their struggle to gain early control over land before others. It is also more time consuming than that of the development permit, although there are fewer steps to be taken. Again, the procedure leaves room for the payment of extra money to speed up the process. Table 1.0 shows how much time it took some applicants to obtain two permits.

The data collected from the survey was multivariate data. This is so because the variables of interest are more than two. The experts who prepared the drawings for the prospective clients' building project development were carefully considered in the research. Another was to find out whether there were legal acquisitions of the land for development. Also, the survey looked at the type of landlords/ladies (landownership) before the purchase of land for development.

## **RESEARCH METHOD**

Most of the literature was of primary sources such as reports/ occasional papers and government publication. Some of the work was also from secondary sources like textbooks, newspapers and magazines. Literature of other people's contribution was also reviewed in the process in order to identify common issues raised by other writers. That was in a way to know sound criticism made by previous researchers.

Some aspects of the information and data were captured through quantitative research approach – objective in nature (Naoum, 2004) The data obtained were hard and reliable, they were measurements of tangible, countable features of sensate (Bouma and Arkinson 1995) Hypothesis test was also conducted The method was selected to achieve actual evidence and arrive at the level of non usage of approved drawings.

Some of the data and information were sorted using qualitative approach which was subjective in nature. That aspect of the research was exploratory due to the limited amount of knowledge about the people (client-landlord/ladies) and contractors/other developers building structures without approved drawings which implied development and building permit were not obtained. The knowledge was arrived

at by face to face interview of clients(building owners), contractors, site engineers, from house to house and from site to site respectively. It was necessary to use such research method as part of the data collection technique because the builders would not know the extent of documentation of their client or would not want to ask about them. That offered an opportunity for the researcher to meet a good number of landlord/ladies, contractors, engineers and site foremen. This diagnosis was meant to know why haphazard construction, sub standard and irregular road networks occur on new construction sites in Ghanaian construction industry. Primary data was obtained from people acting in the natural courses of their daily lives (Naoum, 2004). The survey was more of a descriptive one. It was to find out clients contractors or builders who were in the habit of using approved drawings in the construction of residential buildings (attitudinal in nature).

Landlords, building inspectors from metro and sub-metros, Public Works Department (PWD) and Town and Country Planning office were interviewed. Maps for the planned areas were obtained and studied.

This part of the research was covered with semi structured interviews. After the data and all necessary information had been obtained the results were analysed using recording of information method. That recording of information was an important step in the research process which helped to produce the data development summary sheet. That summary sheet was useful in the transfer of all information and data gathered into a recording scheme (Naoum, 2004). The researcher used the summary sheet to categorize the building drawings into approved/unapproved, with permit/without permit, completed/uncompleted, occupied/unoccupied, in water ways, lowland, upland, well drained areas and wet areas in a useful order for analysis. Descriptive statistics was used, particularly frequency distribution where percentages of some



issues were to look at the general distribution as in the pie chart in the data analysis of the buildings in topographical terms. Further, analysis was conducted to find out how many of buildings were of order or unplanned location and in waterways.

## RESULTS

It was difficult to find accurate data of the number of buildings in any of the case study areas from the Town and Country Planning Department (T.C.P.D) and the Kumasi Metropolitan Assembly (KMA) offices to carry out analysis to establish the extent of the use of unproved drawings. Hundred building owners or prospective developers were targeted and 100 questionnaires sent to them. In addition, two different set of 20 and 40 questionnaires were sent to building, inspectors and builders respectively. The collection of the responses from the building owners was carried out by going from house to house in each of the areas. In the case of the responses from the builders, they were collected from them on their various sites within the case study area

From the 140 questionnaires sent to clients and builders, it was found that 30 respondents engaged the services of qualified architects representing 23.81%. From Table IV it was clear that 96 clients and builders did not involve qualified architects in the preparation of their working drawings. The personnel mostly used were the draughtsman. Out of the 126 building owners (clients) and builders, 67 building owners (clients) and builders representing 53.17% the response level was achieved the remaining a building owners (clients) and builders went to other personnel.

### Building permit acquisition/ topographical study

Table 2.0a shows a summary of the findings; it indicates an 89% response rate.

Table 2.0a Building permit acquisition

Location	No. of Building Surveyed	Questionnaires		No. of Building Owners Visited		
		Administered	Response	Not sure	Without Permit	With Permit
Daban Patuda	156	25	22	2	20	-
Adoato near Bantama	234	25	19	3	19	3
Denkyemboso	103	25	24	2	21	3
New site						
Nsenie near Kentikronu	196	25	24	4	17	6
Total	689	100	89	11	77	12

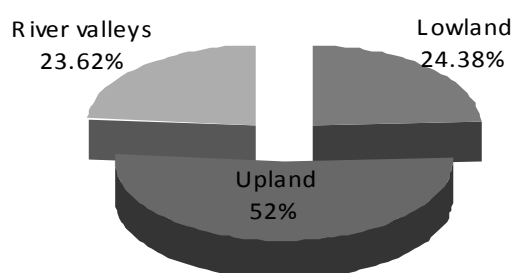
A total number of 77 responses representing 86.5% of the building owners confirmed that up to the time of the study, they had no building permit, (Ref Table 2.0A). It followed from the study that the same number of building owners had no approval for their drawings. Poor sitting of buildings was also evident. This is confirmed by the data analysis of the distribution of buildings as shown in Table 2.0 B and the pie chart in Figure 1.0. The Topographical distribution of buildings as shown on the pie chart in figure 1.0 shows that over 50% of buildings were on upland of well-drained areas. This represents 360 buildings. Furthermore, out of 689 buildings covered during the survey in the case study areas, as many as 329 representing 48% of buildings were

sited in low-lying lands and in valley areas which were predominantly on wetlands and waterways.

Table 2.0B: Distribution of buildings in all four selected areas according to their topography

Area	No of Buildings	Percentage No of Buildings	No of Buildings with Permits	Percentage No of Buildings with Permits
Lowland	167	24.38	-	-
Upland	360	52	12	1.74
River valleys	162	23.62	-	-
TOTAL	689	100	12	1.74

**Figure 1.0: Topographical Distribution of Buildings in all the Four selected areas**



Percentage no of permit acquisition in all the four selected areas was found in the upland areas as 1.74%

### Data on construction stages/ levels of buildings

From the study of Table 2.0c, 72 buildings were unauthorized structures. All of them had been marked for demolition by KMA buildings inspectorate division. As can be seen from Table 2.0c, the buildings in the area were at various stages of completion. For example, 443 out of 689 represent 64% had been completed for use or were being used, as illustrated on Table 2.0c for easy identification of various totals of the stages reached. This table is given to show the distribution of buildings in the four selected case study areas.

Table 2.0c Summary of constructional stages/ levels of buildings

Stage/ level	A	B	C	D	E	F	G	Total	Remarks
No. of buildings	6	10	43	34	43	110	443	689	Most of the buildings are occupied
No. of building with warning indication	-	-	5	5	4	4	54	72	Marked Red 'Stop'

Notes: A - Setting out Stage; B - Trench Excavation Stage; C - Complete Substructure Stage; D - Window Sill level; E - Lintel Level; F - Roof Level; G - Fully completed stage

There was clear evidence from close examination that most of them were of poor layout. Those which were even completed and occupied showed difficulty in getting public space and access. Revelation at the town and country planning department shows that some districts of the case study area, Daban Patuda, in particular have not been fully laid out according to planning standards. This had made it impossible for

development and building permit to be acquired. Table 2.0C indicates there were greater number of on-going construction activities and the possibility of an increased number of buildings without legal documents. All the stages of construction of the studied areas are illustrated in Table 2.0C. It is obvious that the stages or levels followed an increasing pattern of minimum numbers of buildings (at setting out stages) from left to maximum numbers of buildings (at completion stages) on the right. (The distribution is skewed to the right). Therefore, from Table 2.0C it is seen that most of the buildings studied have been completed for use or are being used. The Table above (2.0C) suggests some reasons for many unauthorized structures dotted around because from 2.0B only 12 buildings out of 689 buildings surveyed had building permits. At the initial stages of development (setting out stage to the substructure stage) the study showed limited number of prospective developers. Those interviewed claimed they were protecting their plots, preventing re-entering by the chief. Hence they started development without approved working drawings. However Table 2.0C indicates that most of the buildings are completed in use. So, that answers why unauthorised structures have sprung up in the Kumasi metropolis.

### Statistical analysis

The following hypotheses (or assertions) upon which the research is based are statistically tested to ascertain their validity.

Most developers build without building permits and approved drawings.

Most developers do not use drawings from qualified architects in constructing their buildings.

These hypotheses were tested using the proportion of developed structures without approved drawings and also without using drawings from qualified architects. These hypotheses seem to be a general perception of government authorities and Kumasi Metropolitan Assembly officials but are not scaled by any specific verification.

### The Hypothesis Test I

I. Hypothesis:

**Null Hypothesis:** It is proposed that at least 90% of developed structures are without approved drawings.

**Alternative Hypothesis:** Less than 90% of developed structures are without approved drawings.

To test this, random samples of 100 prospective developers/ clients in the private housing sector were selected and given questionnaires to complete. 89 of these responded and 77 were without building permits and approved drawings. The responses are analyzed using the test about the proportion and a level of significance  $\alpha = 0.05$ .

ii. The estimate of the required proportion.

$$P^{\wedge} = \frac{77}{89} = 0.87$$

iii. The test-statistic,

$$z = \frac{p - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$

$$z = \frac{0.87 - 0.90}{\sqrt{\frac{0.90(0.10)}{89}}}$$

$$Z = -0.94$$

Which is compared with the critical value,  $Z_{0.05} = -1.65$

#### iv. Conclusion

The null hypothesis is failed to be rejected since the test-statistic value (-0.94) does not fall in the critical region. It is, therefore, concluded that the claim that most developers build without building permits and approved drawings is true, using a significance level of 5%

### The Hypothesis Test II

i. **Hypotheses: Null Hypothesis:** it is also proposed that at least 80% of developed structures were not constructed with drawings from qualified architects.

**Alternative Hypothesis:** Less than 80% of developed structures were not constructed with drawings from qualified architects.

To test this random sample of 140 building owners and builders in the private housing sector was selected and questionnaires sent to be completed. Of the 126 responses, 96 did not use drawings from architects. The responses obtained are analyzed using the test about the proportion and the level of significance  $\alpha = 0.05$

ii. The estimate of the required proportion,

$$P = 96/126 = 0.76$$

$$\text{But } P = 0.76, n = 126 \text{ and } P_0 = 0.8$$

iii. The Test statistics

$$Z = (P - P_0) / \sqrt{[P_0(1 - P_0)] / n}$$

$$Z = (0.76 - 0.8) / \sqrt{[0.8(0.20)] / 126}$$

$$Z = -1.1225$$

This is compared with the critical value

$$Z_{0.05} = -1.65$$

#### iv. Conclusion

The null hypothesis is failed to be rejected since the test statistics value (-1.1225) does not fall in the critical region. It is therefore, concluded that the claim that most developers do not use drawings from qualified architects in constructing their buildings is true within the significance level of 5%

## **FACTORS CONTRIBUTING TO THE USE OF UNAPPROVED DRAWINGS**

### **Processing Time of Permit**

From the study, one of the most discussed factors in the private development sector was the acquisition of building permit. The procedure associated with processing of drawings for approval takes a long time. Many building owners and prospective developers lament that the time involved in obtaining land title, development and building permits is sometimes too long. They claimed their plans and programmes of work were disturbed. So they tried to develop their building projects as quickly as possible.

### **Re-entry**

The next issue of great concern was the possible re-entry onto an acquired land. The condition was that if after a period ranging from one to two years the plot was not developed; the said plot could be taken away and given to another client.

In order to beat the deadline for re-entering of the lands by the clients, many prospective developers (according to a large number of people interviewed) are forced to start construction activities without waiting for approval of drawings or building permits.

### **Location**

An attractive geographical location of lands causing a rush of developers to acquire these lands coupled with the fear of losing the site are some factors which force them to use unapproved drawings.

### **Nearness to Development**

Another factor is the nearness of the site to a developed area and a large market centre (like the Greatest Kumasi Business District). Such nearness offers economic prospects but entices people to site illegal structures around.

### **Guidance of Building Inspectors**

Most clients and builders complained of not receiving any good guidance from the building inspectors who happened to visit their project site.

### **Ghanaians Outside/Limited Time of stay to process building document**

Finally, Ghanaians who work outside the country and return home to undertake construction activities contribute greatly to the use of unapproved drawings owing to delays in acquiring land title and building permits. They are therefore forced to undertake construction activities without approved drawings because of loss of confidence and trust in friends and relations coupled with the usually limited time at their disposal, anytime they visit home.

### **Nearness to Relations**

Another issue of concern was the extended family system. Some of the clients or developers wanted to quickly utilize some plots of land so as to be close to the families and other relations.

### **Low Cost of Land**

The price offer for lands in low lying areas and lying in waterways is very low and affordable to some average income developers. They rush for the reserved areas or

unauthorized lands for construction purposes and hurriedly construct to cover those areas using unapproved drawings.

### **Non-involvement of professionals**

From the analysis given, there is a clear indication that developers do not hire the services of qualified professionals like Architects, Quantity Surveyors and Engineers.

This has led to the development of non-coherent and an aesthetically poor environment. This has also led to haphazard land development, in most of the areas studied, making it difficult to identify individual structures by their respective location addresses as in the case of most developed countries.

Failure to use professionals has further led to the sitting of buildings in unauthorized places such as waterways.

## **CONCLUSIONS**

About 90% of building owners use unapproved drawings as recorded in the analysis. It follows that most prospective developers have no land titles; they neither have development nor building permits.

Furthermore, it can be deduced from the above that the central and local governments lose a lot of revenue to the private developer in terms of unpaid fees, yearly. Buildings on wetlands and waterways were found to be about 24% of the total number of buildings. This situation leads to flooding and environmental degradation caused by the accumulation of filth. Also, stagnant water which breeds mosquitoes and harmful insects cause serious health problems. Non-Land demarcation problem was common and for that matter, a good number of building owners claimed, was the cause of their failure to obtain approval for their drawings. According to some developers, builders and building inspectors, some chiefs, after the sale of the lands, do not submit the layout to the appropriate authorities.

## **RECOMMENDATIONS**

The procedure for the acquisition of land title rights, development and building permits should be reviewed to simplify the process. Two main processes can be adopted: i. Entry Point ii. Exit Point

Furthermore, it should be possible for a developer to deposit his/her application and receive building permit and approved drawings by post in less than two weeks. The body or department responsible for the collection of land registration and building permit fees should educate the general public as well as building owners and prospective developers to pay their fees in accordance with laid down regulations.

In addition, the number of building inspectors for the various metros should be increased and where possible, the services of consultants be engaged to help monitor the use of approved drawings.

There should be a legislation to regulate and control the use of all wetlands and waterways.

Finally, the layout from all chiefs and Town and Country Planning Departments should be lodged with the Head office of Town and Country Planning Department, Accra, Regional Offices of Town and Country Planning and Metropolitan or District Assembly Offices before the very transaction of the lease of land begins. Whatever

rectifications to be effected as far as layouts are concerned should have duly met the approval of a national Board of Trustees appointed by the Government of Ghana.

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# ANALYSIS OF HOUSEHOLDS' TRAVEL BEHAVIOUR IN LAGOS METROPOLIS

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This study examines the travel behaviour of households in three different residential density areas of Lagos Metropolis using systematic sampling technique. The results show that variation exists in the travel demand of respondents across the three residential density areas. The mean trip rate and trip length and trip time per person per day is 2.6, 12.00km and 1hour 50 minutes respectively while bus and car mode are dominantly used by respondents for their daily trips. The multiple regression analysis results show that the use of GSM, income, education, employment, car ownership, gender and household size affect travel demand and that these factors also vary across the three residential density areas. This study concludes that planning decisions and policies directed at meeting the mobility needs in any society should not be generalized; rather, it should be made to recognize and respond to the travel demand of different socio-economic groups in the society. It should also take cognizance of the identified factors in the prediction of households' travel behaviour.

Keywords: travel behaviour, travel demand, trip generation, residential density, trip time.

## INTRODUCTION

The challenges of urban mobility have been a major concern for transport planners and city managers in both developed and developing nations. This is because transport is crucial to the socio-economic development of any society. The rapid urbanization occurring across the globe implied that more people than ever before will be living and working in cities and more people and more goods will be making more trips in urban centres, often over long distances (Zegras, 1997). Olanrewaju, Fadare, Akinlo and Alawode (1995) argued that the growth pattern and uncoordinated land use structure have complicated transport demand situation in cities like Lagos. The same reason was noted in Fadare (1987) as responsible for the transport problem in Ibadan. However, Auclair (1999), observed that the travel time, cost and how difficult it is for people to get to and from work have often play a key role in whether a city is able to attract business.

Ayeni (1979) argued that an examination of movement patterns in a city should follow at least two approaches. The first approach involves an examination of some determinants of trips at the household, firm or individual levels while the second is focused on the capacity of the various land uses to generate and attract trips. In adopting the first approach, studies have shown that variations exist in the socio-economic attributes of urban residents as a result of the density of their residential areas which has implications for their trip generation (Fadare, 1987 and Fadare and

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Hay, 1990). Consequently, the objective of this paper is to examine the variation in the travel behaviour of households and the factors responsible for the variations in three distinct residential density areas of Lagos Metropolis.

## **THEORETICAL FRAMEWORK**

The study of travel behaviour over the last half century has yielded critical insights into the choices that individuals and households make about their daily travel (Clifton and Handy, 2001). These insights have contributed to the development of more studies in America, Europe and Asia with increasingly sophisticated methods by researchers and transport experts to understand and predict travel behaviour. The outcome of many of these studies have influenced to a great extent several transport planning decisions and policy issues in many countries of the world (Fadare, 1989, Mokhtarian and Meenakshisundaram, 2002, Srinivasan, 2005). Studies abound on urban travel behaviour in both developed and developing countries and the factors that influence the travel behaviour varies from place to place. (Fadare, 1989, Ogunjumo, 1986, Pucher and Renne, 2003, and Fujiwara, Soehodho and Montalbo, 2005, Asiyanbola 2007).

Fujiwara et al (2005) noted in a study of thirteen cities of Asia, Central America and Middle East that gender influences travel behaviour. The study showed that the trip rate of females is greater than that of males in most cities and that the reverse is the case in some Islamic cities such as Cairo and Kuala Lumpur. This observation tends to suggest that religion or cultural background influence travel behaviour. The study further revealed that, though, age structure is similar among the thirteen cities, the younger generation's trips are greater in Cairo, Managua and Tripoli. On the other hand, the older ones are greater in Japanese cities, Bucharest and Chengdu in China. The high rate of aged people's trips in Chengdu according to the study might be due to the effect of the single child policy in China.

Also, income and car-ownership been noted as part of factors that influence travel behaviour (Pucher and Renne, 2003, Fadare, 1989, Ogunjumo, 1986). In the US, Pucher and Renne (2003) noted that three-quarter of even the poorest households owns a car and further observed that increase in number of cars per household have minor additional impacts on travel behavior. It was also observed that high income households make more trips per day than low income households and travel longer distance about twice that of low income household. Morikawa et al (2001) observed that several factors such age, employment, income and transport subsidy influence travel behaviour in Bangkok, Kuala Lumpur, Manila and Nagoya. Srinivasan and Rogers (2005) noted that women conducted more trips and tended to use the least expensive mode in Chennai. Apart from gender, Srinivasan (2005) found that number of vehicles in the household and the income level were significant socio-economic factors influencing travel behaviour in Chennai, India.

Maunder (1981) in a study of two contrasting socio-economic areas of Delhi (India) noted that variations exist in the weekday trip generation of households. In the case of Ibadan, Nigeria Fadare and Hay (1990) observed that trip mode and trip length and their determinants varied significantly across the three housing density areas. They therefore concluded that variation in housing density significantly affects trip generation of households. The main objective of this paper is to determine the extent to which the conclusion of Fadare and Hay (1990) is true for Lagos.

## THE CONTEXT OF LAGOS

Lagos Metropolis is located in Lagos State in the South-Western part of Nigeria (See Figure1). It is the largest metropolitan area in Nigeria (Ayeni 1968, 1979). According to the 2006 national population census in Nigeria, Lagos State has a population of about 9 million out of a national estimate of 140million (National Population Commission, 2006). Of this population, metropolitan Lagos, an area covering 37% of the land area of Lagos State is home to 85% of the state population (Lagos State, 2004b). Also, Lagos has the highest vehicular density in Nigeria (222 vehicles/km) as against the national average of 11 vehicles/km and by 2025, it will become the third largest global city with an estimated population of 24 million people (Lagos State, 2004a). These scenarios have great implications for future travel demand in Lagos.



Fig 1: Map of Nigeria showing Lagos State

### Characteristics of residential areas in Lagos metropolis

The residential areas in Lagos have been broadly classified into three homogenous densities which are low, medium and high density residential areas. The nature and characteristics of these densities areas have been analysed by scholars (Sada, 1975, Ayeni, 1979, and Oduwaye, 2005). The low density residential areas have the common characteristic of having well planned layouts. Most of the houses stand in the midst of well-kept lawns surrounded by neatly trimmed hedges. Except for blocks of flats, the houses are generally single family houses. Such areas include East Marina and Victoria Island, Ikoyi, Apapa, Ogudu and Ikeja Government Reservation Area.

Similarly, the medium density residential areas share the common characteristics of having been planned and laid out in the early 1960s to satisfy the need of the middle income households in the formal sector. They include residential areas like Surulere, Yaba/ Ebute-Metta, Ikeja and part of Lagos Island. Dominant housing types here are bungalows, and semi-detached two-storey buildings with density of housing generally higher than what obtains in the high low density residential areas.

The high density residential areas are usually located in the central area of precolonial neighbourhoods and in the core areas occupied by the first group of immigrants. These districts include old Lagos, North Central Lagos, Mushin, Yaba East, Mushin, Somolu and Ajegunle-Araromi. Such areas now exist in the urban fringe as Abule Egba, Ipaja, Alagbado and Ojokoro in the north and to the south eastern part are Ijanikin and Iba. They constitute the poorest grade of residential areas as they were never planned. The absence of effective development control and general difficulty of extending the framework of basic amenities across the municipal boundary were also responsible for the poor environmental and housing conditions in these areas.



Fig. 2: Image of a typical low density residential area



Fig. 3: Image of a typical medium density residential area



Fig. 4: Image of a typical high density residential area

## RESEARCH APPROACH

A total of 157 residential areas which have been stratified into three homogenous residential densities (low, medium and high) were identified in this study. To reflect the proportion of population in each of the density areas, every 15<sup>th</sup> house was systematically selected in the low density areas; every 40<sup>th</sup> and every 20<sup>th</sup> house were systematically selected in the medium and high density areas respectively. This gave a total of 1946 buildings which represents the total number of questionnaires administered. However, a total of 1785 duly completed questionnaires were used for data analysis. Eight socio-economic variables (gender, age, education, employment, income, household size, car ownership and use of GSM) and five travel variables (trip frequency, trip purpose, trip mode, trip length and trip time) of households were considered in the analysis. The Analysis of variance test was used to determine the variations in these variables between the three residential density areas. The multiple regression analysis was used to establish the determinants of travel behaviour of households across the three residential density areas.

## RESULTS AND DISCUSSION

### Socio-economic characteristics of respondents

Specific socio-economic attributes of respondents analysed in this section include gender, age, education, employment, income, household size, car ownership and use

of Global System of Mobile Telecommunication (GSM). The patterns of these variables across the three residential densities are subsequently discussed.

### **Gender and age**

Gender analysis in this study indicates that 62.0% of the respondents are males and 38.0% are females. The age structure shows that 70.8% of the respondents are not more than 40 years in age. Respondents within the age bracket of 41 and 50 years are 18.8% of the sample size. Similarly, 10.3% of the respondents are above 50 years. Further, the table indicates that respondents who are in their productive years (20-60 years) constituted 94.0% of the sample size. Respondents below 20 years and above 60 years represent 3.8% and 2.2% respectively.

### **Education, employment and income**

Analysis of education status of respondents reveals that majority (97.6%) of respondents has formal education while those without formal education are only 2.4%. Further, 58.7% of the respondents have Bachelors degree and above. This suggests that majority of the respondents are relatively educated. The employment structure reveals that 70.6% are employed (44.7% formal and 25.9% informal), 7.3% are unemployed, and 18.3% are students while 3.9% are retired. The availability of job opportunities in Lagos may also be responsible for high level of employment recorded among the respondents. However, the relatively high proportion of students (18.3%) among the respondents could be explained by the opportunities for part-time studies provided by institution of higher learning in Lagos. This implies a relatively high level of employment among the respondents and this may be due to the fact that many of them are relatively educated. Within the context of prevailing income level in Lagos metropolis, three income groups may be identified. These are low income (less than N50, 000), medium income (N50, 000 – N100, 000) and high income (above N100, 000). Analysis of monthly income of respondents indicates that 65.9% of respondents are low income earners, 21.2% are middle income earners while 12.8% are high income earners. In general terms, the majority of the respondents are within the low-income group.

### **Household size, car ownership and use of GSM**

Household size of respondents is categorized into three (small, medium and large). Households with 4 members and below are “small sized” whereas the medium sized household” has between 5 and 8 members. The “large sized household” has more than 8 members. Analysis of household size indicates that respondents of small sized households represent 35.4% of the total respondents. The respondents of medium sized households represent 57.0% of the total households interviewed. Respondents from large sized households are 7.7% of the total sample size. This implies that medium sized household is prevalent in Lagos metropolis. The car ownership pattern indicates that 19.3% of the households have no car or any other type of vehicle. Respondents with just one vehicle account for 33.6% of the respondents while owners of two vehicles represent 29.0% of the sample size. Households with three vehicles and above represent 18.0% of the respondents. In general low car ownership was found to be prevalent among households in Lagos metropolis. This may be due to the prevalence of low income households in the city. Analysis of respondents’ access to GSM services is shows that 2.9% of them do not have personal access to GSM services while 97.1% has personal access to at least one GSM service. The analysis further reveals that 54.3% of the respondents have personal access to one GSM

service, 34.2% has two, and 7.7% has 3 while 1.0% has more than three services. This suggests a very high accessibility of respondents to telecommunication facilities.

### **Analysis of variance (ANOVA) of households' socio-economic variables between the residential density areas**

The major proposition in this paper is that there is a significant difference in the socio-economic characteristics of households which is capable of producing variation in households' travel behaviour between residential density areas in Lagos. Table 1 shows the analysis of variance (ANOVA) test of eight socio-economic variables (gender, age, education, employment, income, household size, car ownership and use of GSM) between the residential density areas and reveals that two of the variables (gender,  $F = .183$  and employment,  $F = .343$ ) do not vary significantly between density areas at  $p < 0.05$ . However, other six variables (age,  $F = 3.054$ , education,  $F = 17.829$ , income,  $F = 34.932$ , household size,  $F = 8.701$  and car ownership,  $F = 88.770$  and Use of GSM,  $F = 14.912$ ) are significant at  $p < 0.05$ . This implies that each of the three residential density areas are distinct socio-economic enclaves and thus provided a good basis for further analysis of the households' trip generation between the residential density areas.

Table 1: Analysis of variance (ANOVA) of households' socio-economic variables between the residential density areas

Household variable		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.086	2	.043	.183	.833
	Within Groups	420.866	1782	.236		
	Total	420.952	1784			
Age	Between Groups	7.522	2	3.761	3.054	.047
	Within Groups	2194.593	1782	1.232		
	Total	2202.115	1784			
Education	Between Groups	46.560	2	23.280	17.829	.000
	Within Groups	2326.826	1782	1.306		
	Total	2373.386	1784			
Employment	Between Groups	1.091	2	.546	.343	.709
	Within Groups	2831.471	1782	1.589		
	Total	2832.562	1784			
Monthly Income	Between Groups	70.208	2	35.104	34.932	.000
	Within Groups	1790.791	1782	1.005		
	Total	1860.999	1784			
Household Size	Between Groups	17.942	2	8.971	8.701	.000
	Within Groups	1837.316	1782	1.031		
	Total	1855.258	1784			
Household Car Ownership	Between Groups	223.689	2	111.845	88.770	.000
	Within Groups	2245.196	1782	1.260		
	Total	2468.885	1784			
Use of GSM	Between Groups	15.246	2	7.623	14.912	.000
	Within Groups	910.954	1782	.511		
	Total	926.199	1784			

## **Travel characteristics of households**

### **Trip frequency**

Analysis of respondents' trip frequency across density areas shows that respondents who made one and three trips per day account for the major difference in households' trip rate in Lagos. The proportion of respondents who made just one trip on the average is 51.1%. This figure rose to 53.4% in high density and 54.2% in medium density areas respectively and reduces to 41.5% in low density areas. Those who made three trips constitutes 20.2% in low density area and the figures for medium and high density areas are much lower, 9.6% and 9.8% respectively. Thus, Respondents in low density areas are found to have higher trip rate than those in the medium and high density areas. The mean trip rate per person per day is 2.9, 2.6 and 2.6 in the low, medium and high density areas respectively. This may be due to high car ownership rate among the households in the low density areas.

### **Mode of travel**

The variation in the respondents' mode of travel in the three density areas is more pronounced among the users of cars, taxis and buses. Analysis of trip mode shows that cars are predominantly used in low and medium density areas while buses are predominantly used by respondents in the high density areas. The percentage for users of cars in low density (65.2%) is higher than that of the medium (44.1%) and high density (34.5%). This may be due to the high car ownership rate earlier established among the respondents in low density areas. Also taxi mode is mostly used by respondents in low density area (6.1%) while the percentage for medium and high area is 3.3% and 3.4% respectively. The use of bus mode also reveals clear variations across density areas. While respondents who use bus mode constitute 41.3% in the high density area, the figure is reduced to 31.2% in the medium and 18.4% in the low density area. This is an indication of low car ownership rate among respondents in the high and medium density thus making them rely on public transport, which is dominated by the bus mode.

### **Trip length**

The variation in the trip length of respondents across the density areas is more pronounced for trip length above 20km than other trip length category. This study reveals that respondents who made trips above 20km represent 30.3% in low density area, 10.6% in medium and 12.5% in the high density area. The difference also appears to be significant for respondents who made trips lesser than 1km. while the percentage for medium and high density areas appear very close (13.2% and 12.6%) that of low density is much lower (7.4%). Thus, it could be said that trip length higher than 20km is dominated by respondents in the low density area while trips lesser than 1km is dominated by respondents in the medium and high density areas.

### **Trip time**

Analysis of trip time of respondents also shows variation across density areas. The results show that the percentage of respondents who made trips lesser than 30 minutes is 25.0%, 31.4% and 28.3% in the low, medium and high density residential areas respectively. However, the variation in the proportion of respondents is more significant across density areas for trips between 30 minutes and one hour. The percentage of respondents whose trip time falls into this category is 44.4% in low density. This figure drops to 37.0% in high density and 33.1% in medium density area

### Analysis of variance of households' travel behaviour between residential density areas

The descriptive analysis of the travel patterns of households has reveals similarities and differences between the distinct residential density areas. However, the level of significance of the variations is not known. Consequently, this section discusses the analysis of variance test on the households' travel behaviour across the residential density areas. From the result of ANOVA test in Table 2, the computed F value for trip purpose (.563,  $p < 0.05$ ) and trip time (1.422,  $p < 0.05$ ) were not significant. Hence, trip purpose and trip time do not vary significantly between the residential areas.

On the contrary, the computed F value for trip frequency (4.052), trip mode (7.218) and trip length (12.701) were all significant at 0.05. This implied that a significant difference exist in the households' trip frequency, trip mode and trip length and consequently households' travel behaviour between the three residential density areas.

Table 2: Summary of ANOVA testing the variations in households' travel variables between the three residential density areas

Household Variable		Sum of Squares	df	Mean Square	F	Sig.
Trip Frequency	Between Groups	11.921	2	5.960	4.052	.018
	Within Groups	2621.071	1782	1.471		
	Total	2632.992	1784			
Mode of Travel	Between Groups	40.112	2	20.056	7.218	.001
	Within Groups	4951.582	1782	2.779		
	Total	4991.694	1784			
Trip Length	Between Groups	70.189	2	35.095	12.701	.000
	Within Groups	4923.908	1782	2.763		
	Total	4994.097	1784			
Trip Time	Between Groups	4.541	2	2.271	1.422	.242
	Within Groups	2845.772	1782	1.597		
	Total	2850.314	1784			

The socio-economic variables that account for the observed variation in the travel behaviour and their degree of influence in each of the residential density areas are not known and consequently need to be established. This is achieved through multiple regression analysis, the results of which are subsequently discussed.

### Multivariate analysis of factors affecting travel behaviour

This section discusses the results of the multiple regression analysis in which the household's trip frequency was used as the dependent variable and the eight socioeconomic variables as independent variable. The results of this analysis reveal similarities and differences in the explanation of the household trip generation between the three residential density areas. In the low density residential areas the coefficient of explanation ( $R^2$ ) for the combined independent variables is 0.657 (65.7%). Use of GSM services provides the highest coefficient of explanation ( $R^2$ ). It accounts for 45.0% of the total variation in the household trip frequency. The inclusion of income in the model increases the  $R^2$  to 56.1% while education increases the  $R^2$  to 62.2%. Employment increases  $R^2$  a little to 65.7%. This tends to suggest that the use of GSM by households in the low density areas significantly affects their trip generation more than any other factor.



Similarly, in the medium density areas, four (use of GSM, income, education and employment) of the eight variables jointly provide explanation for the variation in households' trip length. The results indicate that the value of  $R^2$  for the combined independent variables is 0.684 (68.4%). Income provides the highest contribution of 39.2% to the value of  $R^2$  which increases to 52.8% when use of GSM was included in the model. The value of  $R^2$  increases to 61.2% and 68.4% when car-ownership and education are respectively included in the model. This indicates that income more than any other factor has significant contribution to the explanation of the variation in the household trip generation in the medium density areas.

The regression model obtained for the high density residential areas reveals that the combined value of  $R^2$  for the best four predictors of trip frequency in the high density areas is 60.2%. Income provides the highest contribution of 42.1% which increases to 50.8% when education was included in the model and increases further to 56.6% and 60.2% when household size and car ownership are respectively included in the model. This indicates that income is the most significant socioeconomic variable of households that provides explanation for the variation in the household trip generation in the high density areas.

## CONCLUSION

This study provides insights into the socio-economic attributes and travel behaviour of households in the different residential density areas of Lagos Metropolis. It has also established that significant variations exist in the socio-economic attributes and trip generation, travel mode and trip length of households between the residential density areas. Further, it reveals that the factors that provide explanation for the observed variation in travel behaviour of households are both similar and different across residential density areas. In general, the use of GSM, income, education, employment car-ownership, household-size and gender are identified as predictors of travel demand in the residential density areas of Lagos. Consequently, the theory of disaggregating urban households into homogenous socio-economic groups for the purpose of understanding their travel behaviour was found to be useful. This study therefore concludes that residential density affects travel behaviour. Hence, planning decisions and policies directed at meeting the mobility needs in Lagos should not be generalized. Rather, it should be made to recognize and respond to the travel demand of different socio-economic groups in the society and take cognizance of the use of GSM, income, education, employment, car ownership and household-size and gender in the prediction of household travel behaviour.

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# ANALYZING QUANTITATIVE DATA USING FACTOR ANALYSIS: REFLECTIONS FROM AN EMPIRICAL STUDY

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The role of quantitative research is to help researchers appreciate the reliability and validity of scientific knowledge using numbers. Concomitantly, the variables often encountered in quantitative research design can be numerous and complex. A powerful statistical tool that can be used to summarize large amounts of such data and also identify any inherent relationships is factor analysis. Factor analysis is a useful for establishing the underlying structure of sets of interrelated variables without imposing any preconceived composition on the outcome. Drawing on an empirical study, the major analytical requirements for the appropriate use of this rigorous contemporary tool are discussed. Given the increasing use of quantitative survey data in research designs, lessons learnt should prove invaluable to especially emerging researchers faced with understanding the underlying constructs of the multiple and interrelated variables often encountered in research designs.

Keywords: factor analysis, quantitative data.

## INTRODUCTION

In analyzing data, researchers regard two main traditions: the quantitative and qualitative paradigm (Blaikie, 2003). The underlying philosophy in the quantitative paradigm is that any social phenomenon obeys a natural law and can thus be subjected to mathematical logic (see e.g. Walliman, 2003)). Acquiescing to the notion of mathematical logic means the need for statistical tools in making sense of data gathered (cf. Herbert, 1999). Factor analysis, is an important option that provides a rich multivariate approach towards exploring the underlying features of multiple and interrelated variables, without any preconceived judgement (Hair et al, 1998; Field, 2005). In particular, the tool is widely acknowledged as useful for screening and properly managing the interpretation of the too many variables often encountered in many research designs. Drawing on a recently completed study, evidence is provided here to help reinforce the potential of the tool towards helping to understand the complex relationship that exists amongst the many multiple variables often associated with research designs. Given the increasing use of quantitative data in explaining especially contemporary social phenomenon, emerging researchers, be it educators, administrators, government officials, business leaders, human service providers and

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health care professionals ( who are unfamiliar with the technique) would find the tool an invaluable option especially when faced with multiple and interrelated social constructs in their research design.

A synthesis of the role of quantitative research is first provided. This is followed by a preamble on the use of statistics in quantitative data analysis distinguishing between descriptive and inferential statistics. Subsequently *factor analysis* as an inferential statistical tool is introduced including a commentary on the underlying philosophy and its acclaimed robustness. Then follows the key statistical requirements associated with application of the tool. Hence the application of the tool in a management research (specifically construction management research) in the Ghanaian context is discussed including the rigour it provided in helping to address the aims and objectives of the research. The final section provides a reflection on the usefulness of the tool in helping to establish an easily understood framework of the variables used.

## **THE ROLE OF QUANTITATIVE RESEARCH**

The role of quantitative research is to help researchers appreciate the reliability and validity of scientific knowledge using numbers (Blaikie, 2003). In this context, it is important to distinguish between the two main statistical approaches, namely, descriptive and inferential (cf. Kreuger and Neumann, 2006). Descriptive statistics involves presenting quantitative data in percentages or using measures of dispersion such as means, standard deviation and/or measures of association (Herbert, 1990; Field, 2005). When quantitative data is analyzed using descriptive statistics, the focus is limited to the data collected or study sample. Thus, descriptive statistics does not provide a basis for generalizing beyond the particular study or sample and/or providing any theoretical meaning (cf. Blaikie, 2003; Rubbin and Babbie, 2003). Alternatively, inferential statistics help rule out chance as a plausible explanation for research findings and thus require potentially more sophisticated tools (ibid). Factor Analysis provides one such option that can help researchers decide whether they can robustly generalise about populations or theoretical processes based on their findings (cf. Field, 2005). Besides, factor analysis is widely acclaimed for establishing an understanding of the underlying relations of multiple and interrelated variables detailed below.

## **WHAT IS FACTOR ANALYSIS?**

Factor analysis is a generic term used to describe a number of analytical tools for reducing the complexity of numerous interrelated data by bringing out the essential information underlying them (Stapleton, 1997). The fundamental logic underlying the technique is to statistically manipulate the empirical relationships among several variables to help reveal hypothetical constructs of the relationships (Kreuger and Neumann, 2003). Thus, where a researcher is faced with; having to effectively manage too many variables in a research design; decide which of the many variables are most important and those that are redundant; having to undertake correlation coefficient analysis between variables but for which the results becomes unwieldy (Suhr, 2000), factor analysis provide a most appropriate solution giving the researcher no room for inputting preconceived ideas. Factor analysis is therefore useful for exploratory research, identification of underlying factors, screening of variables, data summarization, clustering of objects, sampling of variables, index building, and more importantly, establishing the construct validity of any potential measures without imposing any preconceived judgement (cf. Stapleton, 1997; Hair et al, 1998; Norussis, 2000; Field, 2005)).

Here, it is also important to distinguish between the two main established traditions in undertaking factor analysis; exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Traditionally, EFA is associated with exploring the possible underlying factor structure of a set of observed variables so that they can be reduced into a more easily understood framework (Childe, 1990). Alternatively, CFA is used to verify the factor structure of a set of observed variables so that researchers can test hypotheses relating to whether the relationship between observed variables and their underlying latent constructs exists. Thus, in CFA, the researcher uses knowledge of the theory, empirical research or both, to postulate the pattern of relationship a priori and then test the hypothesis statistically (Suhr, 2000). Whether the choice is between EFA and CFA, the reality is that both tools are very much acknowledged for the development of measurement instruments for many research designs such as those relating to index building, assigning weights to items in an index and statistically trying to reduce a large number of indicators to smaller numbers (Kreuger and Neumann, 2003).

## **THE EARLY USE OF FACTOR ANALYSIS**

Evidence suggests that factor analysis was first used in quantitative research by psychologists searching for a neat and tidy way to describe human abilities in the late 19th Century. In this respect Sir Francis Galton, (1811-1911) is noted to have laid down the foundations when attempting to develop a quantitative method to determine the interdependence between 2 variables in the Late 19th/early 20th century. However, it was Karl Pearson who is noted to have explicitly made the effort to put a definition to the technique.

## **UNDERLYING ASSUMPTION OF FACTOR ANALYSIS**

As noted earlier, factor analysis is an inferential statistical tool. This means that, unlike descriptive statistical tools, factor analysis should be used in situations where the researcher intends to estimate the characteristics or patterns of a population from a sample by relying on principles from probability sampling. In this respect, knowledge of the underlying statistical assumptions is required. That is, the variables should; at least be ordinal level measurement, be randomly selected, have a linear relationship, be normally distributed; and should be correlated with each other. The expectation is that, by addressing these observations, the reliability and validity of factor analysis can be enhanced considerably. To demonstrate pragmatically that the researcher has to a reasonable extent satisfied these criteria, a number of preliminary tests need to be undertaken to help establish that the data set is favourable for factor analysis to proceed. A priori to discussing the requisite preliminary tests, the issue of the reliability of the research instrument (RI) needs to be firstly instituted. Reliability of the research instrument means that it should consistently reflect the construct it is measuring. A well-acclaimed option is to subject the RI to Cronbach's reliability test (Field, 2005). Normally the researcher should be looking for a test value approaching 1.00 as this signifies robust reliability of the RI. Having satisfied the reliability of the RI, the researcher can then proceed to undertake the relevant preliminary tests associated with factor analysis especially those relating to the adequacy of the sample size for the analysis to proceed.

Paradoxically, the question of whether the reliability of factor analysis is dependent on the sample size has been debated in the literature resulting in many rules of thumb (Field, 2000; 2005). Some schools of thought contend that in order for the findings from factor analysis to be meaningful, the sample size should be at least 100 (e.g.

Brace et al, 2003). However empirical studies exist where sample sizes as low as 50 have been used (e.g. Shen and Liu, 2003). Indeed, there have been times when it was thought that the appropriate sample size was the most important factor in determining the reliability of factor analysis (Field, 2005). However, with the introduction of simulation and Monte Carlo tests (cf. Guadagnoli and Velicer, 1988), empirical results have shown that the most important factor in determining the reliable factor solution was not only the absolute sample size but rather the absolute magnitude of the factor loadings. The factor loadings are defined as the correlation between the original variables and the factors. The larger the effect (which could be positive or negative) the more likely that variable might be playing a key role in explaining any identifiable relationship. Thus, one could argue that, irrespective of the sample size, the factor loadings could be a significant contributor, to determining reliability and validity of factor analysis (cf. Guadagnoli and Velicer, 1988). Nonetheless, it is always wise for the researcher to undertake the appropriate preliminary tests towards establishing sample size adequacy before proceeding with the analysis.

## **ESTABLISHING SAMPLING ADEQUACY**

The first preliminary test in factor analysis is the test of communalities. This is a measure of the total amount of variance an original variable shares with all other variables included in the analysis, and is very useful in deciding the adequacy of the sample size as well as likely important variables (Field, 2000;2005). Generally average communalities of more than 0.5 are quite encouraging for the researcher (ibid). Equally, it is necessary for the researcher to undertake what is called the Kaiser-Meyer-Olkin (KMO) sampling adequacy test. This test is very pragmatic in convincing the researcher that to all intent and purposes, the sample size is reasonably adequate for the analysis to proceed. In this respect, a KMO of 0.5 is considered poor, 0.6 acceptable and 0.7 plus better. Normally, it is also important to undertake what is called the anti-image matrices to further confirm the adequacy of the sample size, however in situations where the KMO is quite high (e.g. above 0.7), this would not be that necessary. While establishing the adequacy of the sample size, it is usually mandatory to test for correlations amongst the variables by undertaking the Bartlett test of sphericity. This is because a major underlying assumption of factor analysis is that correlations must exist. The Bartlett test should be significant at a probability level less than 0.05 (i.e.  $p < 0.05$ ).

When the researcher is convinced that all the necessary tests have been satisfied including the seemingly controversial adequacy of the sample size, the analysis can then proceed to the substantive stage. If EFA is chosen, then the researcher will perform what is called the principal component analysis, otherwise CFA would be the most appropriate if the research is interested in testing a hypothesis. Like all contemporary statistical tools, computer literacy is important to help facilitate manipulations of the complex statistics involved. The study on which this paper draws used the SPSS version 12.0

## **THE STUDY IN QUESTION**

Here, no hypothesis was tested hence the obvious choice was to use EFA. The following discussion now addresses the application of the EFA as used on the empirical study undertaken in Ghana. In this respect, it is important for readers to also take note of the definitions of the terms as used in EFA:

Component: these are real factors derived from the correlation matrix

**Factors:** these are factors that are hypothetical because they are estimated from the data

**Extraction:** this is the name for the process by which the important factors are identified

**Common variance:** variance shared by other variables in the factor analysis

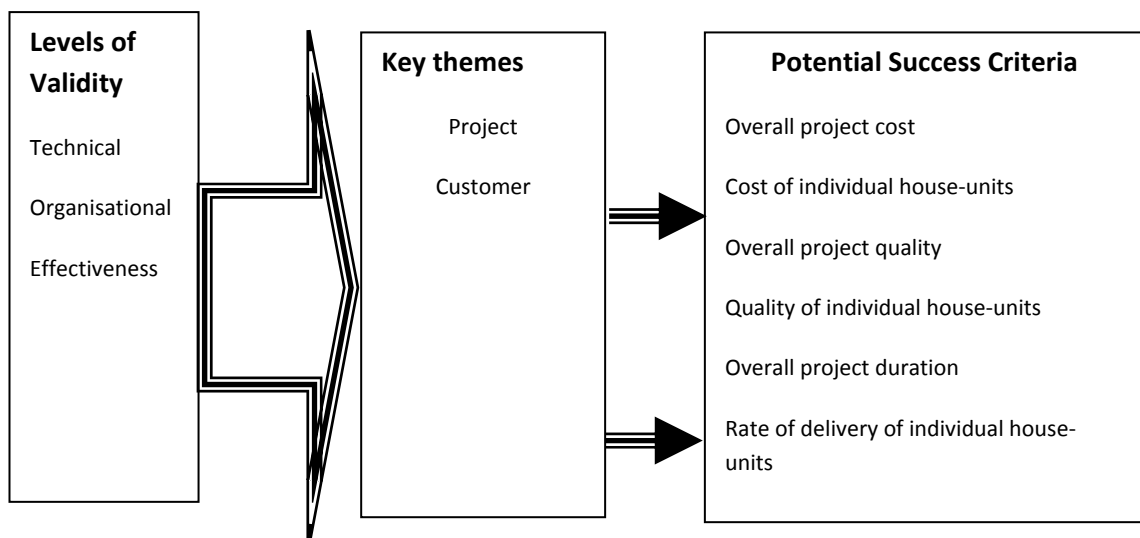
**Eigenvalue:** This is a measure of how much variance is explained by a single factor.

**Scree plot:** This is a useful graph of the eigen values of all the factors initially considered

**Rotation,** this is a mathematical technique embedded in the factor analysis technique used to arrive at the simplest pattern of factor loadings

The study from which the paper emanates was targeted at developing a model to predict the performance of project managers in Mass House Building Projects in Ghana (cf. Ahadzie, 2007). The aim was to come out with a set of competencies that PMs in the Ghanaian housing industry could use for their professional development. However, in developing the model, there was the need to first address the issues of what constitute the determinants of success in MHBPs. A total of 15 variables were therefore proposed in the bid to understand the relation among these variables and how they helped in truly explaining what constitute the determinants of success in MHBPs.

## MATERIALS AND METHOD



**Figure 1:** Project Success Framework for MHBPs

Figure 1 represents a proposed success framework for MHBPs. Drawing on an extensive review of the relevant literature, 15 potential success criteria were proposed. Table 1 provides a definition of the various variables postulated. Readers who are interested in the philosophy underlying the development of these variables should refer to Ahadzie et al (2008b).

## DATA COLLECTION

157 structured questionnaires were administered to senior managers (specifically managing directors) of house-building companies in Ghana to elicit their perceived importance of the 15 potential success criteria. Senior managers were chosen as the unit of analysis as they make the major decisions regarding corporate and project

objectives in Ghana. Subsequently, their perceptions of critical success criteria should help interested stakeholders particularly PMs to have a clearer idea of what is expected of them towards achieving project outputs. The senior managers were invited to indicate the degree of importance of each of the 15 success criteria based on a five-point Likert rating scale of very important=5, important=4, neutral=3, unimportant=2 and not very important= 1. 57 completed questionnaires were returned representing a 37% response rate.

## DATA ANALYSIS

Due to the relatively large number of variables (i.e. potential success criteria) involved in the study, factor analysis was employed to establish which of the variables could be measuring the aspects of the same underlying dimensions.

Table 1: Definition of potential success criteria

Variable	Variable Name	Definition
CSF 1	Overall project cost	Final out-turn cost for overall project including infrastructure such as road networks and street lighting
CSF 2	Cost of individual house-units	Final out-turn cost for individual house-units.
CSF 3	Overall project duration	Time taken to complete entire project including provision of infrastructure such as road works and street lighting
CSF 4	Rate of delivery of individual house-units	Time taken to deliver individual house-units.
CSF 5	Overall project quality	Quality of entire project including associated infrastructure as seen by customers and the public
CSF 6	Quality of individual house-units	Quality of individual house-units as seen by the customer or user
CSF 7	Overall customer satisfaction	Satisfaction of customers with overall project outcomes including infrastructure provision
CSF 8	Customer satisfaction on individual house-units	Satisfaction of customers with individual house –units
CSF 9	Overall risk containment	The extent to which all kinds of risk were contained or minimised
CSF 10	Risk containment on individual house-units	Ditto in relation to individual house-units
CSF 11	Overall environmental impact	Impact of construction waste, environmental degradation and pollution on the general public
CSF 12	Environmental impact of individual house-units	Impact of living environment waste such rubbish, sewage, drainage
CSF 13	Overall health and safety measures	Number of accidents and the extent to which employees use appropriate safety gear and equipment
CSF 14	Health safety measures with individual house-units	Health and safety in terms of health hazard posed by the living environment, poor materials poor construction practices
CSF 15	Technology transfer	The extent to which technology new significantly improves the design and construction of a living space by decreasing installed cost,

Source: Ahadzie *et al.*, 2008b

Furthermore, it was important to reduce the 15 variables into a single index as required by the aim of the original study. The reliability of the research instrument was established using the well acclaimed Cronbach's alpha test. Here, Cronbach's alpha achieved an overall high of 0.8966 validating the reliability of the research instrument for factor analysis. Tables 2 to 6 and Figure 2 represent the test results associated with the factorability and sampling adequacy. Average communality of the variables after extraction was above 0.6 (Table 2); the Kaizer-Meyer-Olkin (KMO) measure of sampling adequacy achieved a high value of 0.75 (Table 3); the Bartlett test of sphericity was also significant suggesting that the population matrix was not an



identity matrix (Table 4). Thus necessary tests in respect of the factorability and adequacy of the sample size were favourable for factor analysis to proceed.

Thereafter, the data was subjected to EFA. The version of EFA in SPSS used for this analysis is the principal component analysis (with varimax rotation). For those who are unfamiliar with the SPSS, the procedure is to go to analyze, then choose scales, choose factor analysis and then click on principal component analysis (cf. Brace et al, 2003; Field, 2000; Field, 2005). Results of the principal component analysis are shown in Table 5. The eigenvalue and factor loadings were set at conventional high values of 1.0 and 0.5 respectively. As shown in Table 6, four components with eigenvalues greater than 1.0 were extracted using the factor loading of 0.50 as the cut-off point. This is confirmed by the scree plot in figure 2. The relatively high values of the loading factor (0.6 for more than four variables) lend support to the favourability of the sample size for the analysis. The total variance (Table 6) explained by each component extracted is as follows; component 1 (42.401%), component 2 (11.233), component 3 (9.530), component 4 (9.115). Thus, the final statistics of the principal component analysis and the components extracted accounted for 72.3% of the total cumulative variance (Table 6).

Table 2: Communalities

	Initial	Extraction
Technology transfer	1	0.578
Health and safety on individual house-units	1	0.774
Overall health and safety measures	1	0.812
Environmental impact of individual house-units	1	0.876
Overall environmental impact	1	0.872
Risk containment on individual house-units	1	0.643
Overall risk containment	1	0.726
Customer/client satisfaction on individual house-units	1	0.773
Overall customer/client satisfaction	1	0.662
Quality of individual house-units	1	0.785
Overall project quality	1	0.632
Rate of delivery of individual house units	1	0.578
Overall project duration	1	0.742
Cost of individual house units	1	0.692
Overall project costs	1	0.777

Source: Ahadzie, 2007

Table 3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.758
Bartlett's Test of Sphericity	Approx. Chi-Square	531.149
	Df	105
	Sig.	0

Source: Ahadzie *et al.*, 2008b

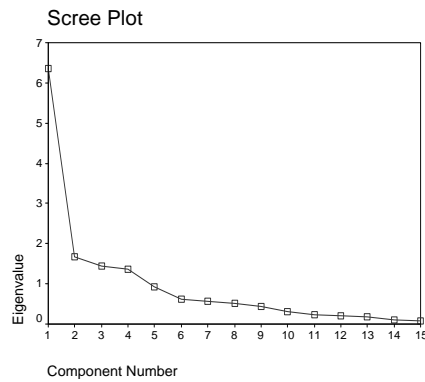


Figure 2: Scree plot for factor analysis

Source: Ahadzie *et al.*, 2008

Table 4: Correlation matrix of factor analysis

Factor	CSF1	CSF2	CSF3	CSF4	CSF5	CSF6	CSF7	CSF8	CSF9	CSF10	CSF11	CSF12	CSF13	CSF14	CSF15
CSF1	1.000														
CSF2	.321	1.000													
CSF3	.292	.082	1.000												
CSF4	.095	.565	.518	1.000											
CSF5	.071	.401	.289	.475	1.000										
CSF6	-.029	.147	.137	.363	.651	1.000									
CSF7	.435	.375	.082	.117	.282	.162	1.000								
CSF8	.190	.235	.095	.209	.397	.304	.549	1.000							
CSF9	.126	.409	.200	.312	.481	.394	.320	.493	1.000						
CSF10	.119	.451	.335	.374	.500	.371	.517	.420	.766	1.000					
CSF11	-.039	.450	.188	.343	.475	.179	.313	.375	.706	.706	1.000				
CSF12	.100	.542	.184	.407	.434	.257	.320	.304	.755	.755	.858	1.000			
CSF13	.174	.216	.198	.315	.422	.511	.396	.522	.686	.624	.424	.495	1.000		
CSF14	.184	.189	.198	.299	.436	.448	.355	.412	.599	.685	.407	.536	.841	1.000	
CSF15	.010	.214	-.001	.129	.443	.474	.214	.453	.435	.356	.155	.173	.446	.381	1.000

Note: Kaiser Meyer-Olkin measure of sampling adequacy=.758; Bartlett test of sphericity=.531.149; Significance=0.000

Note: Explanation to acronyms as in Table 1

Source: Ahadzie et al, 2008

Table 5: Rotated component matrix

	Component			
	1	2	3	4
Overall environmental impact	.909			
Environmental impact of individual house-units	.904			
Overall health and safety measures	.760			
Health and safety on individual house-units	.710			
Customer/client satisfaction on individual house-units		.815		
Technology transfer		.767		
Overall risk containment		.679		
Overall customer/client satisfaction		.619		
Risk containment on individual house-units		.613		
Rate of delivery of individual house units		.528		
Quality of individual house-units			.813	
Cost of individual house units			.772	
Overall project quality			.595	
Overall project costs				.827
Overall project duration				.765
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.				
a Rotation converged in 7 iterations				
Source: Ahadzie et al, 2008				

Based on the rotated component matrix on which the variables load, the researcher can decide a suitable name to describe each factor. Here, based on an examination of the inherent relationships among the variables under each component, the following interpretation was made; component 1 was termed environmental impact; component 2 customer satisfaction; component 3 quality and component 4 cost-time criteria. What this means is that these four components are in fact the underlying constructs of the 15 potential success criteria initially used. Appropriate names were chosen for the components based on the names of the variables with the highest factor loading.

Table 6: Component transformation matrix

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	6.558	43.721	43.721
2	1.68	11.197	54.918
3	1.438	9.586	64.505
4	1.246	8.308	72.813
5	0.921	6.138	78.951
6	0.624	4.157	83.108
7	0.581	3.872	86.98
8	0.458	3.056	90.036
9	0.447	2.981	93.017
10	0.308	2.051	95.067
11	0.221	1.477	96.544
12	0.19	1.267	97.811
13	0.174	1.159	98.971
14	0.086	0.576	99.546
15	0.068	0.454	100

Extraction Method: Principal Component Analysis

Note: Some columns in the table have been removed to make up for space

Source: Ahadzie et al, 2008b

## REFLECTIVE DISCOURSE OF RESULTS

Admittedly quantitative research should be geared towards answering questions about constructs and their interplays in influencing a phenomenon (Blaikie, 2003). The reality is that, in most cases researchers are faced with multiple and numerous variables which would have to be reduced into an easily understood framework (Stapleton, 1997). There is also the difficulty of trying to establish which of the numerous variables could be redundant and those which could be the underlying cause of the same construct (ibid). Factor analysis is an importantly acknowledged tool that can be used to address these concerns so that the researcher to a very reasonable extent removes personal biases from the study. Thus, with factor analysis the researcher has the benefit of a tool that can explain how well multiple variables relate to an underlying factor of a hypothetical construct without any preconceived idea (cf. Field, 2005).

Here, an attempt has been made through the use factor analysis to provide a convenient framework towards enabling systematic understanding of the success criteria in MHBPs in Ghana. Given the complex nature of conceptualizing what constitute success in construction projects it is not strange that as many as 15 potential success criteria were proposed for this study. While it is possible that some of the variables could be redundant or related, it was important not to introduce any preconceived judgement in establishment this. Factor analysis was useful in helping

the authors to achieve this. Furthermore, by reducing the variables from 15 to four major factors, factor analysis made it possible to create a convenient framework for understanding the success criteria better. Here, the analysis revealed that the 15 potential success criteria proposed were in fact the variants of four main components identified as environmental impact, customer satisfaction, quality and cost-time. These findings lend support to some previous works, suggesting its validity in the context of the study (Torbica and Stroh 2001, Tam et al, 2002: Odusami, 2003)

Factor analysis also helps researchers to construct indexes, test the unidimensionality of scales, and assigns weights to items in an index (Kreuger and Neumann, 2006). In addressing one of the key objectives of the study from which the paper emanates, there was the need to undertake multiple regression analysis. However regression analysis requires the dependent variable to be a single item as against independent variables that could be multiple. There was therefore the problem in the said study (from which the paper emanates) on how to reduce the 15 potential success criteria which constituted the dependent variables into a single index. However, with factor analysis it was possible to develop from first principles an index for which construct validity could be inferred beyond a reasonable level of appreciation (cf. Ahadzie et al, 2007; Ahadzie et al, 2008). Indeed, and as in many inferential statistical tools, the statistical theory and algebra on which the technique is based is complex (Kreuger and Neumann, 2006). However with improvement in computer knowledge, softwares now exists (e.g. SPSS) which makes it quite easy for anyone interested to use the technique. What is necessary is for one to acquire the knowledge of how to interpret the results which is achievable with a minimum of training in the use of most of the relevant softwares. Within this context, what is crucial is for the researcher to understand the underlying statistical assumptions that must be followed to improve the reliability and validity of the technique. In this respect, the data would need to be metric although the method is commonly applied to ordinal level data of equal interval categories (Blaikie, 2003). The sample used for factor analysis should also be randomly selected and the population from which the sample is selected should be representative. The controversies surrounding the adequacy of the sample size has been discussed. However, the safer option is that, the larger the sample sizes the better. Moreover, the researcher should ensure that the sample adequacy and factorability test is passed before proceeding to use the technique. With these measures there is the potential of creating enough credibility in the results that would be achieved in using the technique.

## CONCLUSION

Factor analysis is a versatile robust statistical tool for reducing a large number of multiple and interrelated variables to an easily understood framework. To this extent, it can be used to construct indexes, testing unidimensionality of scales, and help in assigning weights to items in an index. Here, the application of the technique is demonstrated to help reinforce its usefulness in quantitative research design involving multiple variables. The statistical assumptions underlying the technique have been discussed and crucial issues relating to the sampling size adequacy and factorability test to be followed have also been illuminated. It is contended that lessons learnt in the application of the technique should be useful for emerging researchers in understanding the relationships that exists in the numerous and multiple variables often encountered in research designs, and also to build index from multiple variables.

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# APPRAISAL OF FACTORS THAT INFLUENCE THE IMPLEMENTATION OF BOT INFRASTRUCTURE PROJECTS IN NIGERIA

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Build-Operate-Transfer (BOT) concept in the context of Public-Private-Partnership is globally accepted arrangement between government and private sector entities for the purpose of providing public infrastructures. Such partnerships are characterized by the sharing of investment, risk, responsibility and reward between the partners. The subject of this study is on BOT concept as a concession procurement option of public infrastructure development, which was recently given a legal recognition as a means of bridging the critical infrastructure gap in Nigeria. Since the introduction of the concept, there have been many problems in real life practice. However, the government and practitioners have still been vague about explaining its success and failure. This study was carried out to evaluate the problems of the current BOT projects on factors that impede its implementation in Nigeria. Questionnaires were designed and administered to respondents such as clients, consultants, developers, lenders and end users of BOT projects across the six geopolitical zones of the federation. Data collected from the questionnaire were analyzed using statistical technique called severity index. The result of the research findings shows that 41 constraint factors were identified, which were further grouped in to four generic factors hindering the successful implementation of BOT projects in Nigeria, namely the political (10 sub-factors), economic (13 sub-factors), legal (10-sub factors) and technical/social risk factors (8 sub-factors). The consequences of these factors have significantly affects the financial viability of the BOT projects in Nigeria, which in turn deprived lenders to fully participate and finance the projects adequately.

Keywords: BOT, developing country, Nigeria, public infrastructure.

## INTRODUCTION

Build-Operate-Transfer (BOT) concept in project management has been increasingly gaining popularity in both developed and developing countries across the globe (PWF Database, 2004). The concept is an essential tool for bridging the critical infrastructure gap and improving investment especially in developing countries where often the governments do not have adequate finances to deliver such public services that attract high capital outlay (Ibrahim, 2005). Developing countries like Africa require extensive infrastructure to meet the various social and economic development challenges (NEPAD, 2001). BOT concept is an integrative procurement model designed to provide unique opportunity for financing public infrastructure facilities and boost the economical growth of the country without utilization of government finances.

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Globally research and implementation on BOT project delivery system has directed various effective routes to utilize private sector funds, technology innovation, management skills and operational efficiencies for the development of public infrastructure services (Tiong, 1995). On the basis of this trend, many developing countries in Asia, Africa, Latin America and Caribbean have begun to promote infrastructure projects for sustainable economic growth.

The use of BOT concept in Nigeria has become imperative where often the government does not have adequate finances to bridge the critical infrastructure gap and improve investment (Nigeria's Economic Reform, 2007). The Nigeria's Infrastructure Summit (2008) show that, the country requires extensive infrastructure to meet the various social and economic development challenges. Consequently, World Bank (2008) has ranked the country 108 out of 178 economies in the world. This is due to the high costs of investment in the country caused by the wide range of infrastructure deficit.

Although, the government of Nigeria had offered various BOT infrastructure projects ranging from tourism facilities, building projects, airport terminals, seaports, railways, roads and bridges. This new form of financing of these public infrastructures that attract high capital outlay is part of the government's efforts in bridging the critical infrastructure gap for sustainable economic growth. Thus, Nigeria is among the developing countries which have been able to exploit the benefits and earn the advantages from the BOT projects.

Experience shows that there is an enormously wide degree of implementation and management strategies for BOT worldwide. This has been the case in Nigeria where political, economic, regulatory, and social conditions are not stable than in more developed countries. Thus, the implementation of BOT projects is reflected by a number of successful cases in the developed and developing world; while in Nigeria majority of BOT projects offered from 2003-2009 never proceed to the physical development stage (Dahiru, 2009). This results in a considerable loss of time, money, effort, and often significant diminution of the theoretical advantage of the BOT concept. Although the federal government of Nigeria has mastered all the potential benefits of embracing BOT concept, but the partnership has not been really successful in the point of view of domestic and foreign investors as well as the government due to numerous constraints. This has also been reported by Wigwe (2008) that the trend of the BOT projects in Nigeria did not get the success in its realization and relevance. Thus, the Nigeria's BOT projects are constituted with constraints which are limiting its success in the country.

However, Nigeria is like many African countries where the implementation of BOT projects is influenced by unstable investment environment such as political, economic, legal, and social risk factors, which hinder its effective implementation in the country. In view of this background, the study had investigated the perception of BOT stakeholders (clients, consultants, developers, lenders, and end users) on these factors and not promising that, it is intended to solve the Nigerian problem with BOT projects.

## **THE FRAMEWORK FOR CRITICAL SUCCESS FACTORS (CSFS) OF BOT IMPLEMENTATION**

Due to the complexity of BOT, the assessment of success and failure of BOT project is not an easy task. Therefore, a number of authors worldwide are inspired in creating



the framework for CSFs to assess and explain why it is the case. Tiong, et al (2002) characterizes six CSFs for winning BOT contract. This include: entrepreneurship, picking the right project, a strong stakeholder team, an imaginative technical solution, competitive financial proposal, inclusion of special features in the bid.

Tam (1999) has presented the successful conditions for BOT projects in Asia after empirical studies from various projects in Hong Kong and Thailand. These frameworks are: viable project, flexible toll fee adjustment, qualified consortium, technical competent, equitable and experienced government authority.

Qiao et al (2001) create the framework for CSFs of BOT projects in China according to six projects phases: preliminaries qualification evaluation phase, tendering phase, concession award phase, construction phase, operation phase, and transfer phase. The authors present independent success factors in each phase following by many dependent factors. These eight independent important CSFs are summarized as: appropriate project identification, stable political and economic situation, attractive financial package, acceptable toll/tariff level, reasonable risk allocation, select suitable sub-contractor, management control, and technology transfer.

Jefferies et al (2002) gives five CSFs through Stadium Australia case study. These consist of: environmental impact, approval process efficiency, technical innovation, developed legal and economic framework, political stability and support, selecting the right project, strategic alliances, complimentary skills, and consortium structure.

Li et al (2005) groups seventeen CSFs in to five principal factors which include the following: effective procurement (7 sub-factors), project implementation ability (5 sub-factors), government guaranteed (2 sub-factors), favourable economic conditions (2 sub-factors), and available financial market (1 sub-factor) for BOT/PPP projects in UK.

Kopenjan (2005) conducts an extensive research from nine transport infrastructure projects in the Netherlands. The researcher recognizes six general factors to enlighten the success/failure cases from the upfront BOT/PPP project phase. These factors include: project characteristics (ie. Project attractiveness), a clear political administrative commitment to the project, joint image building and mutual trust, convincing and motivating plan, good process management, and good process arrangement.

Xiong et al (2006) analyzes twenty one successful factors which grouped in to five generic CSFs for BOT/PPP project in China. These factors are: reasonable risk sharing mechanism, financial system and policy for BOT/PPP projects, the improvement of regulation and policy, rational pricing mechanism, effective supervising mechanism.

Cuttaree (2008) presents nine CSFs from the experience of World Bank in conducting BOT/PPP projects worldwide. The factors include: careful planning of BOT/PPP contract, solid revenue and cost estimate, user willingness to pay and communication plan, extensive feasibility study with the use of BOT/PPP expertise, compliance with contractual agreement, appropriate legal and regulatory framework, strong institutions with appropriate resources, competitive and transparent procurement, mitigation and flexible in managing macro risks.

The literatures presented above are rather enough to demonstrate the framework for CSFs of BOT projects across the globe. Throughout the various literatures review, the study recognizes that some researchers try to create CSFs to assess BOT projects in

general. While others pay attention to specific CSFs for BOT/PPP in their countries such as: UK, Australia, the Netherlands, China, Hong Kong, and Thailand. These contributions are valuable for further research to be conducted on this subject for potential good practice of BOT in the future. It is also observed that these CSFs are varied from countries to countries. It is reasonable because the factors for BOT project success in this country can not be appropriately applied for others due to its potential differences. However, there are a number of critical generic factors agreed among various researchers due to their un-substituted position for a successful BOT project.

## SURVEY DESIGN AND ADMINISTRATION

The respondents were provided with the list of 42 BOT constraint factors identified from the pilot survey conducted on 48 BOT projects to assess their perceived level of severity in a questionnaire instrument. The completed questionnaire comprised four sections: questions about respondents' individual and organizational background and experience; questions about factors that impede BOT implementation; questions about factors influencing the high development costs of BOT projects; and questions about critical success factors for effective BOT project agreement. This paper presents the analysis of the survey of frequency of response data relating to the perceived severity of the identified factors based on severity index and rank. The degree of severity was related to the overall impact that these factors have on the attainment of the successful implementation of BOT projects in compliance with international best practice.

Table 1 Details of responses from the administered questionnaires

Location	Clients		Consultants		Developers		Lenders		End users	
	No R	%No R	No R	%No R	No R	%No R	No R	%No R	No R	%No R
Abuja	9	15.79	9	15.79	8	14.04	8	14.04	9	15.79
Bauchi	7	12.28	6	10.53	4	7.02	5	8.77	6	10.53
Enugu	5	8.77	4	7.02	5	8.77	5	8.77	5	8.77
Kano	8	14.04	7	12.28	6	10.53	7	12.28	6	10.53
Lagos	7	12.28	5	8.77	6	10.53	8	14.04	8	14.04
Plateau	6	10.53	6	10.53	7	12.28	6	10.53	6	10.53
Port	5	8.77	5	8.77	5	8.77	5	8.77	6	10.53
Harcourt	47		42	73.69	41	71.94	44	77.20	46	80.72
Total	82.46									

No.R = No. Responses, %No.R = %No. of Responses.

Table 2 Responses of questionnaires by respondent type and geographical location

Respondent	FCT	North-East	South-East	North-West	South-West	North-Central	South-South	Total	
(Type)	(Abuja)	(Bauchi)	(Enugu)	(Kano)	(Lagos)	(Plateau)	(Rivers)	(Nr)	(%)
Clients	9	7	5	8	7	6	5	47	21.36
Consultants	9	6	4	7	5	6	5	42	19.09
Developers	8	4	5	6	6	7	5	41	18.64
Lenders	8	5	5	7	8	6	5	44	20.00
End users	9	6	5	6	8	6	6	46	20.91
Total	43	28	24	34	34	31	26	220	100

### Survey responses and characteristics of respondents

In all the survey, 220 questionnaires were returned out of the 260 distributed, of which 47 were for clients, 42 consultants, 41 developers, 44 lenders, and 46 end users (Table 1). This represents 84.63% effective response rate. The clients include federal and state government's ministries, department or agencies responsible for the provision of

public infrastructures. Consultants include professional in the construction industry. Developers are simply the project promoters or concessionaires. Lenders include financial institutions such as commercial banks and insurance corporations. End users on the other hand include community group who are the beneficiaries of the services. However, most of these respondents are experienced professionals with 80% having over 15 years of relevant experience in the construction industry.

### **Data analysis**

Statistical analyses were undertaken and the ranking of BOT constraint factors in Nigeria was based on severity index, where a lower value indicates a lower level of severity. Based on the frequency of responses from respondents, severity index (SI) and ranks (R) were computed taking in to consideration the combined weighted average of all responses.

### **Survey Results and Discussions**

Analysis on the perception of respondents on the 41 identified constraint factors that influence the successful implementation of BOT infrastructure projects in Nigeria was carried out. The analysis of the survey response data produced severity index values of the 41 constraint factors ranging from 1.75 - 3.16. Table 3 shows 10 political constraint factors with severity index values of the weighted average of all the respondents: inconsistency of government policy (SI = 3.11, R = 1); Political instability (SI = 3.05 and R = 2); Corruption (SI = 3.04 and R = 3); Foreign policies (SI = 2.56 and R = 4); social unrest (SI = 2.55 and R = 5); poor public decision making process (SI = 2.50 and R = 6); religious crises (SI = 2.46 and R = 7); tariff regulatory policy (SI = 2.36 and R = 8); Nationalization of asset (SI = 2.34 and R = 9); kidnapping (SI = 2.19 and R = 10).

Table 4 shows the 13 identified economic constraint factors with severity index values of all the respondents: weak infrastructures (SI = 3.07 and R = 1); alternative source of energy (SI = 3.05 and R = 2); Availability, convertibility and transferability of foreign currency (SI = 2.74 and R = 3). Financial attraction of project to investors (SI = 2.71 and R = 4). high finance costs ( SI = 2.66 and R = 5); global economic recession (SI = 2.62 and R = 6); Influential economic events ( SI = 2.60 and R = 7); high duties and taxes (SI = 2.52 and R = 8); poor financial market (SI = 2.46 and R = 9); Imbalance demand and supply (SI = 2.45 and R = 10); devaluation of naira (SI = 2.39 and R = 11); foreign reserve ( SI = 2.37 and R = 12); payment by end users (SI = 1.7 and R = 13).

Table 5 includes 10 identified legal constraint factors with severity index values of all the respondents: poor regulations of BOT project agreement (SI = 3.16 and R = 1); inadequate security legislation of BOT contract (SI = 2.74 and R = 2); Inadequate protection of BOT contract rights under governing law (SI = 2.70 and R = 3); undefined tax incentives and concession (SI = 2.63 and R = 4); Unclear legislation on lease and franchising (SI = 2.57 and R = 5); fear of change in tax regulation (SI = 2.56 and R = 6); unclear BOT contract enforceability (SI = 2.41 and R = 7); Unclear legislation to promote foreign investment (SI = 2.39 and R = 8); regulation of import duties (SI = 2.33 and R = 9); fear of industrial regulatory change (SI = 2.27 and R = 10).

Table 6 represents 8 identified technical/social constraint factors with severity index values of all the respondents: inexperience government in handling BOT transaction (SI = 3.01 and R = 1); Poor tendering process and award mechanism (SI = 2.99 and R

= 2); inadequate BOT expertise (SI = 2.89 and R = 3); lack of public awareness (SI = 2.70 and R = 4); over dependency of importation of materials, plants and equipments (SI = 2.51 and R = 5); lack of government support (SI = 2.48 and R = 6); lack of tradition of private provision of public services (SI = 2.46 and R = 7); high level of bureaucracy (SI = 2.45 and R = 8).

Table 3 Severity Index (SI) and Ranks (R) of the identified political constraint factors responsible in limiting the successful implementation of BOT projects in Nigeria.

Political constraint factors	Severity Index for the responses					Weighted average for all respondents	Ranks
	Cl	Co	De	Le	En		
1 Political instability	3.15	2.91	3.07	2.96	3.15	3.05	2
2 Poor public decision making	2.66	2.57	2.24	2.30	2.74	2.50	6
Process	2.51	2.50	2.66	2.36	2.76	2.56	4
3 Foreign policies	2.98	3.14	3.27	3.11	3.07	3.11	1
4 Inconsistency of govt policies	3.23	3.29	3.00	2.64	3.04	3.04	3
5 Corruption	2.60	1.74	1.81	2.00	2.78	2.19	10
6 Kidnapping	2.64	2.33	2.34	2.27	2.74	2.46	7
7 Religious crises	2.43	2.31	2.63	2.71	2.65	2.55	5
8 Social unrest	2.17	2.41	2.05	2.32	2.83	2.36	8
9 Tariff regulatory policy	2.04	2.10	2.34	2.55	2.67	2.34	9
10 Nationalization of asset							

Notes: Cl = Clients, Co = Consultants, De = Developers, Le = Lenders, En = End users.

Table 4 Severity Index (SI) and Ranks (R) of the identified Economic constraint factors responsible in limiting the successful implementation of BOT projects in Nigeria.

Economic constraint factors	Severity Index for the responses					Weighted average for all respondents	Ranks
	Cl	Co	De	Le	En		
1 High finance costs	2.43	2.60	2.78	2.73	2.76	2.66	5
2 High duties and taxes	2.57	2.45	2.46	2.52	2.59	2.52	8
3 Imbalance supply and demand	2.64	2.26	2.66	2.30	2.37	2.45	10
4 Alternative energy source	2.96	3.19	3.10	2.98	3.02	3.05	2
5 Weak infrastructures	2.92	3.07	3.24	3.05	3.09	3.07	1
6 Foreign reserve	2.13	2.05	2.44	2.59	2.65	2.37	12
7 Devaluation of naira	2.45	2.21	2.24	2.50	2.57	2.39	11
8 Poor financial market	2.60	2.71	2.39	2.27	2.35	2.46	9
9 Influential economic events	2.40	2.69	2.73	2.59	2.61	2.60	7
10 Payment by end users	1.45	1.79	1.49	1.96	2.04	1.75	13
11 Financial attraction of project to investors	2.83	2.91	2.81	2.48	2.54	2.71	4
	2.64	2.83	2.66	2.75	2.84	2.74	3
12 Availability, convertibility and transferability of foreign Currency	2.53	2.57	2.61	2.66	2.72	2.62	6
13 Global economic recession							

Notes: Cl = Clients, Co = Consultants, De = Developers, Le = Lenders, En = End users.

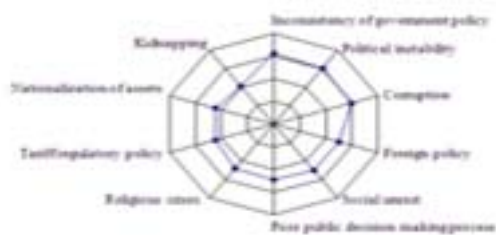


Figure 1 Major political constraints in BOT projects in Nigeria

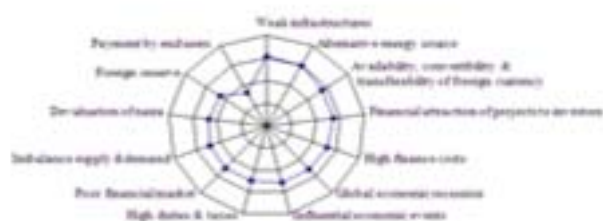


Figure 2 Major economic constraints in BOT projects in Nigeria

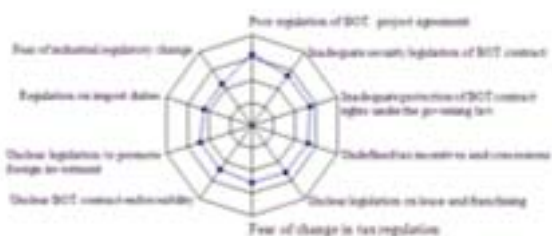


Figure 3 Major Legal constraints in BOT projects in Nigeria

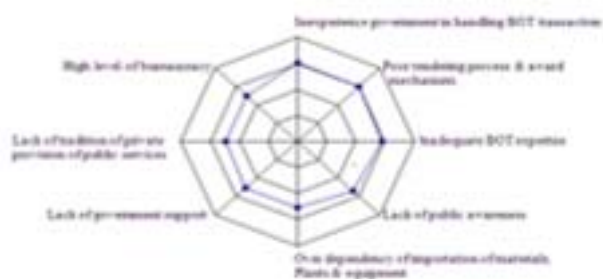


Figure 4 Major technical/social constraints in BOT projects in Nigeria

Table 5 Severity Index (SI) and Ranks (R) of the identified Legal constraint factors responsible in limiting the successful implementation of BOT projects in Nigeria.

Legal constraint factors	Severity Index for the responses					Weighted average for all respondents	Ranks
	Cl	Co	De	Le	En		
1 Fear of change in tax regulation	2.47	2.74	2.61	2.50	2.48	2.56	6
2 Fear of industrial regulatory change	2.30	2.41	2.07	2.27	2.30	2.27	10
	3.00	3.26	3.15	3.23	3.17	3.16	1
3 Poor regulation of BOT project agreement	2.72	2.81	3.05	2.64	2.48	2.74	2
	2.47	2.57	2.24	2.30	2.37	2.39	8
4 Inadequate security legislation of BOT contract	2.62	2.36	2.49	2.66	2.72	2.57	5
	2.66	2.86	2.54	2.71	2.74	2.70	3
5 Unclear legislation to promote foreign investment	2.34	2.69	2.15	2.46	2.41	2.41	7
	2.62	2.55	2.78	2.57	2.63	2.63	4
6 Unclear legislation on lease and franchising	2.26	1.83	2.44	2.52	2.59	2.33	9
7 Inadequate protection of BOT contract rights under the governing law							
8 Unclear BOT contract enforceability							
9 undefined tax incentives and Concessions							
10 Regulation on import duties							

Table 6 Severity Index (SI) and Ranks (R) of the identified Technical/social constraint factors responsible in limiting the successful implementation of BOT projects in Nigeria.

Technical/Other constraint factors	Severity Index for the responses					Weighted AVG for respondents	Ranks
	Cl	Co	De	Le	En		
1 Inexperience govt in handling BOT transaction	3.04	2.98	2.66	3.16	3.20	3.01	1
	2.79	2.81	2.83	2.98	3.02	2.89	3
2 Inadequate BOT expertise	2.83	2.79	2.71	2.55	2.61	2.70	4
3 Lack of public awareness	2.81	2.74	2.39	2.11	2.20	2.45	8
4 High level of bureaucracy	2.85	3.05	2.81	3.09	3.13	2.99	2
5 Poor tendering process and award	1.68	2.74	2.27	2.77	2.83	2.46	7
	2.43	2.67	2.61	2.30	2.37	2.48	6
mechanism	2.64	2.26	2.46	2.61	2.67	2.53	5
6 Lack of tradition of private Provision of public services							
7 Lack of government support							
8 Over dependency of importation of materials, plants and equipments							

Notes: Cl = Clients, Co = Consultants, De = Developers, Le = Lenders, En = End user

## CONCLUSION

BOT procurement approach is being practiced worldwide for infrastructure development. This mechanism has a great potential in bridging the gap between the great need for essential infrastructure projects and available public funding. Nigeria has begun to realize that BOT is an extremely useful tool in aiding the building of infrastructure. The study has evaluated the practice of BOT approach and described the results of a questionnaire survey that investigated the perception of BOT stakeholders (clients, consultants, developers, lenders and end users) on the relative constraint factors influencing its successful implementation in Nigeria.

BOT projects in Nigeria are inherently high risk investments in which political, economic, legal, and social instability has significantly influenced the financial viability of the projects, which in turn has significantly deprived lenders to fully participate and finance the projects adequately. The consequences of these factors have great impact in limiting the implementation of BOT projects in the country. Various studies and surveys have identified that, any decision by the public sector to implement BOT projects must be based upon an assessment of the political, economic, legal, and social risk factors surrounding the BOT investment at the implementation stage.

This paper provides an assessment of the political, economic, legal, and social constraint factors responsible in limiting the BOT implementation in Nigeria. The study has also focus on establishing the existence and degree of impact of interdependencies between these factors via the survey of both public and private sector BOT project participants in Nigeria.

The most constraint factors surrounding BOT investment in terms of funding in the Nigerian environment found by the questionnaire survey are as follows:

- Political risk factors (inconsistency of government policy; political instability; corruption; foreign policies; social unrest; poor public decision making process; religious crises; tariff regulatory policy; and kidnapping) [10 sub-factors].
- Economic risk factors (weak infrastructures; alternative source of energy; availability, convertibility and transferability of foreign currency; financial attraction of project to investors; high finance costs; global economic recession; influential economic events; high duties and taxes; poor financial market; imbalance demand and supply; devaluation of naira; payment by end users) [13 sub-factors].
- Legal risk factors (poor regulation of BOT project agreement; inadequate security legislation of BOT contract; Inadequate protection of BOT contract rights under governing law; undefined tax incentives and concession; unclear legislation on lease and franchising; fear of change in tax regulation; unclear BOT contract enforceability; unclear legislation to promote foreign investment; regulation of import duties; fear of industrial regulatory change) [10 sub factors].
- Technical/social risk factors (inexperience government in handling BOT transaction; Poor tendering process and award mechanism, inadequate BOT expertise; lack of public awareness; over dependency of importation of materials, plants and equipments; lack of government support; lack of tradition of private provision of public services; high level of bureaucracy;) [8 sub-factors].

Finally, the determination of these factors surrounding the BOT investment in Nigeria will pave way to the public sectors in improving the financial viability of BOT projects that can attract more investors in the country. This will equally ease lenders in eliminating the difficulties of financing BOT projects in Nigeria.

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# ASSESSMENT OF GOVERNMENTAL INTERVENTION TOWARDS TOURISM DEVELOPMENT OF IDANRE HILLS, ONDO STATE, NIGERIA

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The government of Ondo state and the people of Idanre are quite aware of the tourism potentials of Idanre Hills. However, the government should be conscious that no sustainable tourism can develop without direct government intervention and interests. The state of the buildings at the hill top is in dereliction. The aim of the study is to assess current intervention strategies. The construction of the stairway leading to the top of the hill, is a major government intervention, initially there was no stairway. Tourists had to be escorted, sometimes carried to get to the top of the hill. Later, the stairway was constructed having a total of 450 risers. The stairway has been reconstructed and the risers are now between 150mm and 180mm at the most, with total numbering 617 steps. Another intervention by the government is the construction of five numbers, relaxation units for tourists climbing the stairs. These units were ingeniously designed and constructed. Also renovation of the first primary school in Idanre was carried out. Case study method was used for the collection of primary data. The village at the top of the hill was visited in January 2008, October 2009 and February 2010. During each visits, pictures was used for recording the extent of governmental intervention. Results show that the state government is actually working albeit at snails speed. The consequence of the work is that the government should be made to understand that a more cutting edge approach should be adopted to drive the wheel of tourism development and preservation of the heritage of the hilltop village.

Keywords: government, Idanre, intervention, tourism, Nigeria.

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# **APPRAISAL OF THE PUBLIC PRIVATE PARTNERSHIP IN RESIDENTIAL HOUSING DELIVERY FOR LOW INCOME GROUP IN THE NORTH-CENTRAL GEO-POLITICAL ZONE, NIGERIA**

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Previous studies indicate that public housing provision in Nigeria has failed to increase housing supply or improve housing condition in any significant manner. Public Private Partnership (PPP) programme, though in its infancy, is not without hitches. Problems such as weak public sector capacity, weak private sector, and inaccessibility of low income earners to the houses among others are factors militating against this housing delivery system. The research therefore, intends to investigate the efficacy of public private partnership in housing delivery in the North Central Geo- Political Zone of Nigeria with a view to examining the relationship between the stake holders and comparing the method adopted in the three states of Kwara, Niger, Nassarawa and Abuja, as there is no or insignificant record of the existence of PPP housing in the remaining states (Kogi, Plateau and Benue). The study intends to use multi- strategy approach in sourcing data from primary and secondary sources. The data will be analyzed using statistical tools such as Descriptive Statistics for the housing estates and occupiers characteristics, Ranking will be used to show the significance of the factors affecting the development of PPP. ANOVA, Correlation Matrix, Multiple Regression Analysis will be used to investigate how these factors such as level of incomes, accessibility to mortgages, allocation criteria are interrelated and Game Theory will be used to study the relationship between partners. The result of the study is expected to provide a basis for future policy formulation on PPP housing delivery in Nigeria.

Keywords: partnership, housing delivery, low income, mortgage.

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# **BUILDING INTEGRATION PHOTOVOLTAIC MODULE WITH REFERENCE TO GHANA: USING TRIPLE-JUNCTION AMORPHOUS SILICON**

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This paper assesses the potential for using building integrated photovoltaic (BIPV) roof shingles made from triple-junction amorphous silicon (3a-Si) for electrification and as a roofing material in tropical countries, such as Accra, Ghana. A model roof was constructed using triple-junction amorphous (3a-Si) PV on one section and conventional roofing tiles on the other. The performance of the PV module and tiles were measured, over a range of ambient temperatures and solar irradiance. PVSyst (a computer design software) was used to determine the most appropriate angle of tilt. It was observed that 3a-Si performs well in conditions such as Accra, because it is insensitive to high temperatures. Building integration gives security benefits, and reduces construction costs and embodied energy, compared to freestanding PV systems. Again, it serves as a means of protection from salt spray from the oceans and works well even when shaded. However, compared to conventional roofing materials, 3a-Si would increase the indoor temperature by 1-2 °C depending on the surface area of the roof covered with the PV modules. The results presented in this research enhance the understanding of varying factors involved in the selection of an appropriate method of PV installation to offset the short falls of the conventional roofing material in Ghana.

Keywords: Building Integrated Photovoltaic, Triple-junction Amorphous (3a-Si), performance, PVSyst.

## **INTRODUCTION**

Renewable energy technologies have been in use in Ghana for many years, and account for about 89% of electricity generation, although solar photovoltaic (PV) accounts for a small percentage. Ghana has installed a total electric generation capacity of more than 1.7 Gigawatts, from which it is estimated that PV installation totals up to 1.0MW ([www.ghanaef.org](http://www.ghanaef.org)) approximately 0.01% of the total Electricity supply ([www.hedon.info](http://www.hedon.info)). However, more than one-third of the population are still without power. Though these areas are mostly rural, parts of the capital city (Accra) are constantly under load shedding to enable industries to operate, while other parts are in total darkness.

Ghana like all the countries in the Sub-Sahara region (West Africa) have a good solar energy resource, receiving daily solar irradiation of between 4 and 6 kWh/m<sup>2</sup> and a corresponding annual sunshine duration of 1800 - 3000 hours. In Ghana, solar radiation levels are higher in the northern regions which include a large portion of the rural areas of the country ([www.ared.org](http://www.ared.org)). With respect to PV, it is estimated that amongst 90% of installation is in the Northern part of the country due to its scattered settlements (houses) and hence grid-electrification would not be viable. Most of these

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installations are standalone systems (off-grid) ([www.ared.org](http://www.ared.org)). The only building integrated photovoltaic (BIPV) system known in Ghana is a 50 kWp system installed on the roof of the Ministry of Energy. This is serving a dual purpose: (a) for workshop demonstration and (b) generating power to the grid ([www.energycom.gov.gh](http://www.energycom.gov.gh)).

### **Glossary of key terminologies**

**Solar Energy:** The solar energy definition is quite simple to understand, see below for additional information on this form of energy ([www.solarbuzz.com](http://www.solarbuzz.com)).

**Photovoltaics (PV):** this is the direct conversion of light into electrical energy through a solar cell.

**PV Module:** several PV cells interconnected to form an assembled package.

**Array(s):** two or more PV modules connected in series and/or in parallel ([www.solarbuzz.com](http://www.solarbuzz.com)).

**Building Integrated Photovoltaic (BIPV):** it is a system that consists of integrating photovoltaics modules into the building envelope, such as the roof or the façade. The system simultaneously serves as a building envelope material and a power generator ([www.wbdg.org](http://www.wbdg.org)).

**Stand-alone PV System (off-grid):** An independent solar PV system that operates without connection to a grid but capable to supply electricity. They are normally used in remote or isolated places where the electric supply from the power-grid is unavailable or not available at a reasonable cost ([www.solarenergyhome.co.uk](http://www.solarenergyhome.co.uk)). It is also known as autonomous PV systems

**Watt peak (Wp):** The power output when a Solar module is illuminated under standard conditions of  $1000 \text{ W m}^{-2}$  intensity,  $25^\circ\text{C}$  ambient temperature and a spectrum that relates to Air Mass 1.5.

**Irradiance:** The solar power incident on a surface, usually expressed in kilowatts per square meter ( $\text{kW m}^{-2}$ ) ([www.solarbuzz.com](http://www.solarbuzz.com)). It is also a solar flux density incident on a surface in  $\text{W m}^{-2}$ . Irradiance multiplied by time gives insolation.

**Irradiation:** this is the solar energy incident on a surface over a specified period, often expressed in  $\text{J m}^{-2}$  per day or  $\text{kWh m}^{-2}$  per day.

### **Conventional Roofing and Adverse Effects**

The main roofing materials used in Ghana are; aluminium and asbestos roofing sheets, concrete roofs and tiles (in the minority), except for some rural areas where straw and/or grass are used. The most common of these is aluminium, basically because it is less costly. However, for a city such as Accra, the Atlantic Ocean which borders the south of the country has a strong adverse effect on such roofing materials as they tend to corrode due to the salt spray from the ocean. As a result, it requires replacement after about 15 years. Also, in some extreme weather conditions this roofing material tends to blow off rendering it unsafe for occupants. Considering the economy of Ghana this option may be just right but for a brief period. Building Integrated Photovoltaic (BIPV) modules could be a viable alternative for most roofing materials in Ghana. It would not only serve as a roofing material but would also be a source of electrification, security and it would also resist the effect of corrosion from the salt spray.

### **Research Purpose: Choice of Method**

The abundance of sunlight makes PV systems a solution to solve some, if not all of Ghana's energy crisis. Until now, a number of the PV systems installed have fallen in a state of disrepair due to lack of maintenance, or available accessories (especially storage systems) rendering the entire project a white elephant. This may be attributed

to the fact that most of the PV installations (standalone systems) are owned by communities or individuals who know very little or nothing about the system and how it works. As a result, using PV systems integrated into the building structure (roof) instead of roofing materials is considered to be the most robust approach to avert these shortfalls. In this research, triple-junction amorphous silicon (3a-Si), SHR-17, is investigated as a potential BIPV. This is because, according to manufacturers, it works better in high temperature conditions ([www.uni-solar.com](http://www.uni-solar.com)) and it is easy to integrate into building façades. It is envisaged that the 3a-Si shingles could replace the conventional roofing material and serve in the following capacities;

- As a roofing material-security
- Power generation.

To be able to verify these, several tests; to assess the temperature, and shading effects, characteristics of the module were conducted on a shed (to simulate conditions in a house) mounted at the test site of the Metrological department (University of Reading).

## AIM

The aim of this research is to assess the potential for using building-integrated photovoltaic roof shingles made from triple-junction amorphous silicon (3a-si) as a roofing material and for electrification in tropical countries, such as Accra, Ghana.

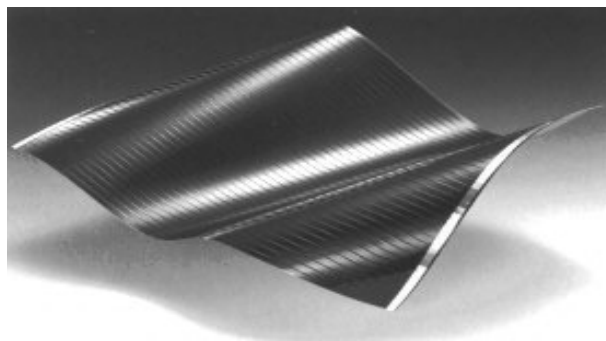
## OBJECTIVES

The objectives to achieve this aim are:

- Optimization of angle of tilt
- To determine the different effects of temperature on roofing tiles and triple junction amorphous-silicon (3a-Si).
- To measure the current-voltage characteristics of the shingles.
- To measure the performance of the shingles at high and low irradiance

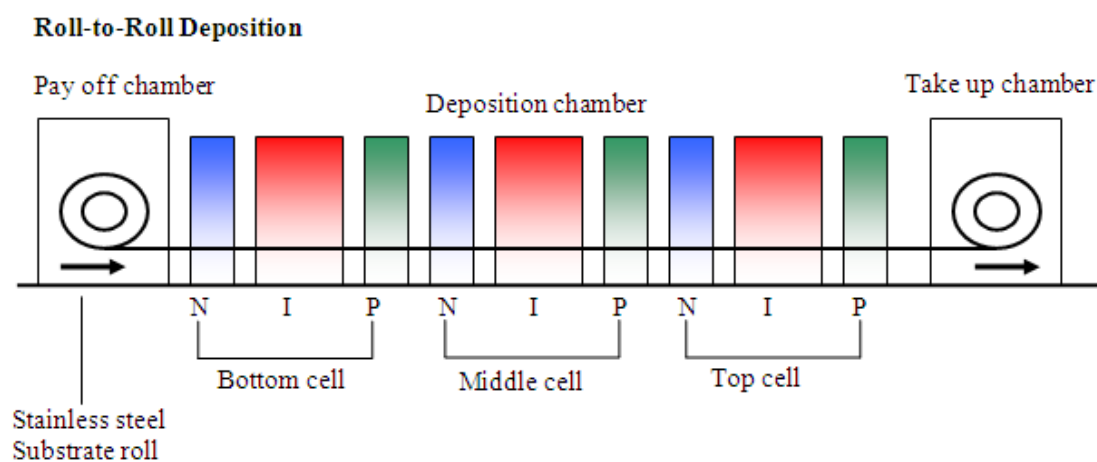
## BACKGROUND OF EXISTING THEORY AND TECHNOLOGY

Triple-junction amorphous technology was introduced at the end of 1997 by Uni-solar to overcome some of the shortfalls of amorphous-silicon technology (Figure 1). Solar cells using amorphous silicon have different form of junction between the positive (p-) and the negative (n-) material. The junction normally formed is known as the *p-i-n* junction, where “i” is an intrinsic material (Boyle, 2000). The Uni-solar product is based on a sophisticated multi-layer of amorphous silicon thin film solar cell developed originally by energy conversion devices.



**Figure 1** Cell of triple junction amorphous silicon (*Source: Essah, 2002*)

The construction of the spectrum-splitting cell shown in Figure 1 is illustrated schematically in Figures 2. The construction is based on three separate **p-i-n** sub-cells, on a roll-to-roll vacuum deposition process which uses a continuous roll of stainless steel sheet as the substrate upon which the cells are mounted. The three amorphous semiconductor sub-cells are designed and built such that each has different spectral response characteristics (no numerical data was given for the different responses). This enables the cell to convert the various wavelengths of sunlight with maximum efficiency. The spectrum splitting capacity of the cell is such that, the bottom sub-cell (red-cell) absorbs red light, the middle sub-cell (green-cell; **p-type**) absorbs green light and that on top (blue-cell; **n-type**) absorbs blue light. The fact that it is capable of absorbing the various aspects of light is the key to its high efficiency and higher energy output, especially at lower irradiation levels and diffuse light conditions.



**Figure 2** Schematic layout of the roll-to-roll deposition (Source: Essah, 2002)

The cells are then inter-connected and assembled into modules which are encapsulated in ultra-violet stabilised and weather resistant polymers and framed with anodized aluminium at the front, which further enhance the durability of the module as well as reducing cost. A coated galvalume steel backing plate provides stiffness (Essah, 2002).

The operation of the PV effect in amorphous silicon is generally similar to that of crystalline silicon, except that in 3a-Si, the band gap is less clearly defined although it is wider. This improves its efficiency over that of single-junction amorphous silicon because the cell absorbs well over a wide wavelength range. It is also known to have an improved performance under diffused radiation. Also, by-pass diodes are integrated to each cell, allowing the modules to produce power even when partially shaded (Essah, 2002). Manufacturers recommend that, it is weather resistant ([www.uni-solar.com](http://www.uni-solar.com)) and able to withstand high temperatures (values not specified).

In addition, several factors influence the performance of all photovoltaic modules. These include the solar irradiance level, operating temperature, solar spectrum and the angle of incidence at which sunlight strikes the module. Based on these, the modules must be compared under Standard Test Conditions, which are:

- Solar irradiance  $1000\text{Wm}^{-2}$
- Air mass 1.5 spectrum



- Cell temperature 25°C

## METHOD

### DESIGN AND CONSTRUCTION OF SHED

To simulate the effects of the shingles an already built shed was used. The dimensions of the shed was; 1.83 m by length, 1.22 m by width and 1.80 m by height. The area occupied by the roof of the shed was practically too small ( $1.3 \text{ m}^2$ ) to be used for the 2.25 m shingles, hence a new one ( $2.0 \text{ m}^2$ ) was built to serve the purpose. The specifications of the Uni-Solar SHR-17 shingles are two fold;

- Electrical:** - rated at 17Wp (watt peak), with a Voc of 13 V and Isc of 2.35 A. It has a maximum voltage point of 9 V and that of current is 1.9 A.
- Dimensions:** - a single 3a-Si measures 0.13 m in width and 2.25 m in length, with an extending polymer lamination of width approximately 0.25 m for the same length.

### Building the Roof

One side of the new roof was designed and built taking into consideration the number (six in all), and the length of the shingles (about 2.25 m). The other side was designed as a conventional tiled roof to simulate a normal roof. The dimensions of the new roof sections were approximately  $2 \text{ m}^2$  (2.25 m by 0.8 m) each. It was impossible to mount the roof sections side by side because of the size of the shed, which would have been the most appropriate situation. The type of tiles used is known as the Light Mixed Brindle, noted to withstand stormy weather conditions and efficient for roofing structures of inclined angles greater than  $20^\circ$ . After construction, the weight of the separate sections was as follows: weight of total roof with shingles on was 32.7 kg and that of the roof with battens and tiles was 96 kg.

### The Shed



**Figure 3** Section of the shed with shingles south facing

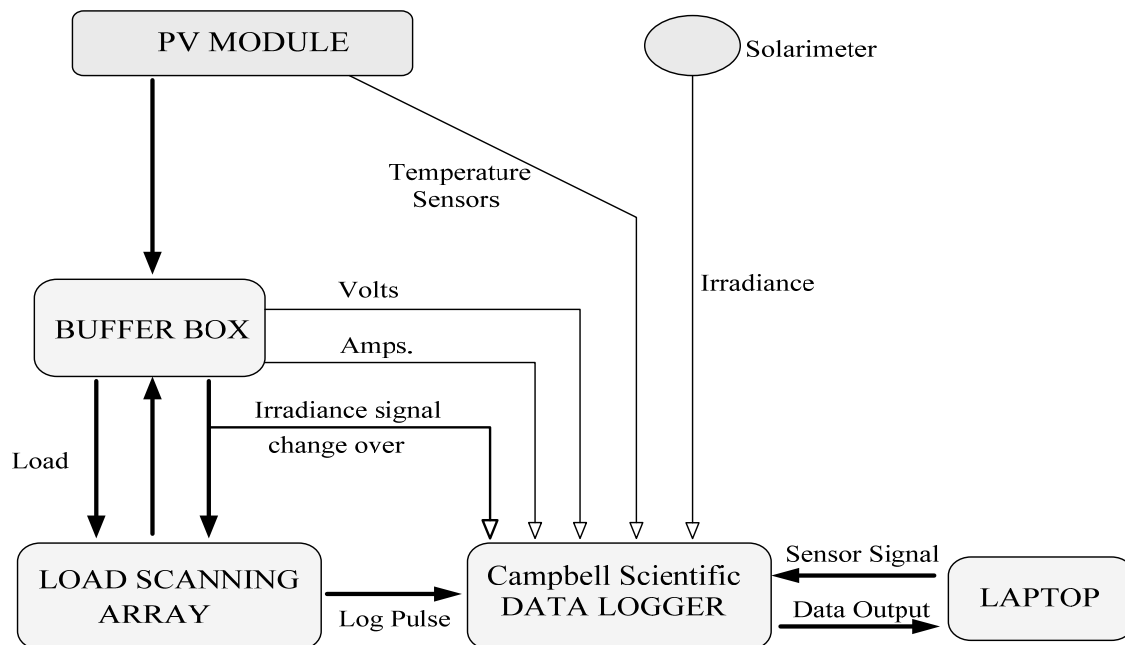
**Figure 4** Section of the shed with tiles, north facing

The shingles were oriented south facing at a slope angle of  $45^\circ$  corresponding to that of the shed roof (Figure 3). However, as would be determined in Section below the most appropriate angle depends on location and latitude). The other section of the

shed, which is north facing (Figure 4) had the tiles on, oriented at the same angle as that of the shingles.

### EXPERIMENT: SYSTEM SET-UP

Thermocouples of type *K* were used in obtaining temperature readings from six different parts of the shed. It measures between the range of  $-200^{\circ}\text{C}$  to  $+1200^{\circ}\text{C}$  and has a sensitivity of approximately  $41\mu\text{V}/^{\circ}\text{C}$  ([www.picotech.com](http://www.picotech.com)). All thermocouples were then connected to a Model 3081 Hybrid recorder, logging every second and averaging over a minute. A Kipp SP-lite semiconductor solarimeter was also connected to the section of the roof which was south facing at the same roof angle, through to a channel on the recorder. The sensitivity of the solarimeter was  $10\mu\text{V}/\text{Wm}^{-2}$ . The shingles were connected as pairs in series with the three pairs connected in parallel because that is the normal way they are connected. Figure 5 illustrates a block diagram of the system set-up.



**Figure 5** Block diagram of the set-up used for module characteristics

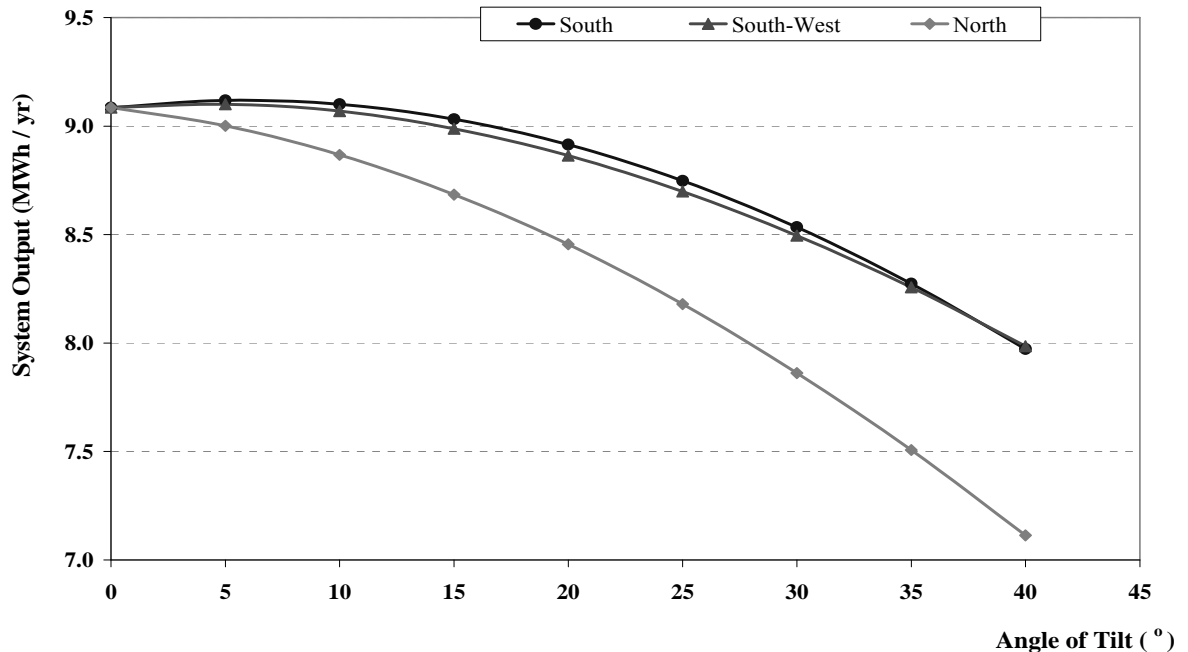
To simulate normal operation, the energy produced by the shingles was used to charge a 56Ah battery. The shingles were connected to the battery through a Solstice MX120 charge controller and a load of about 22 ohms set by a variable resistor was also connected.

## RESULTS AND DISCUSSION

### OPTIMUM ANGLE OF TILT

The optimum pitched angle for most buildings (domestic and offices) in Ghana are between the ranges of  $30^{\circ}$  to  $45^{\circ}$ , as a result most BIPV (if any) will be considered at this angle. However, because Ghana is close to the Equator the angle of inclination of the panel is affected by this latitude. Considering this condition and the most appropriate azimuth, PVSyst; a computer based software package for the study, sizing and data analysis of complete PV systems ([www.pvsyst.com](http://www.pvsyst.com)), was used for sensitivity

analysis. It is evident that the most appropriate tilt angle for effective output is at 5° and South facing because Ghana is close to the Equator. Considering current pitched angles in Ghana (30°- 45°), about 20% of the output is lost even before energy is generated. Where it is oriented in any direction but for South facing, then a further loss is incurred (Figure 6).



**Figure 6:** Effect of tilt angle and azimuth

## DIFFERENCE IN TEMPERATURE VERSES IRRADIATION

In this section the effects of 3a-Si/ tiles with temperature differences is assessed. A graph of difference in temperature ( $\Delta T$ ) against irradiation ( $H$ ) is a first simple approach to verify this. The graph below shows results of data collected over a period of fourteen days for each roofing section south facing.

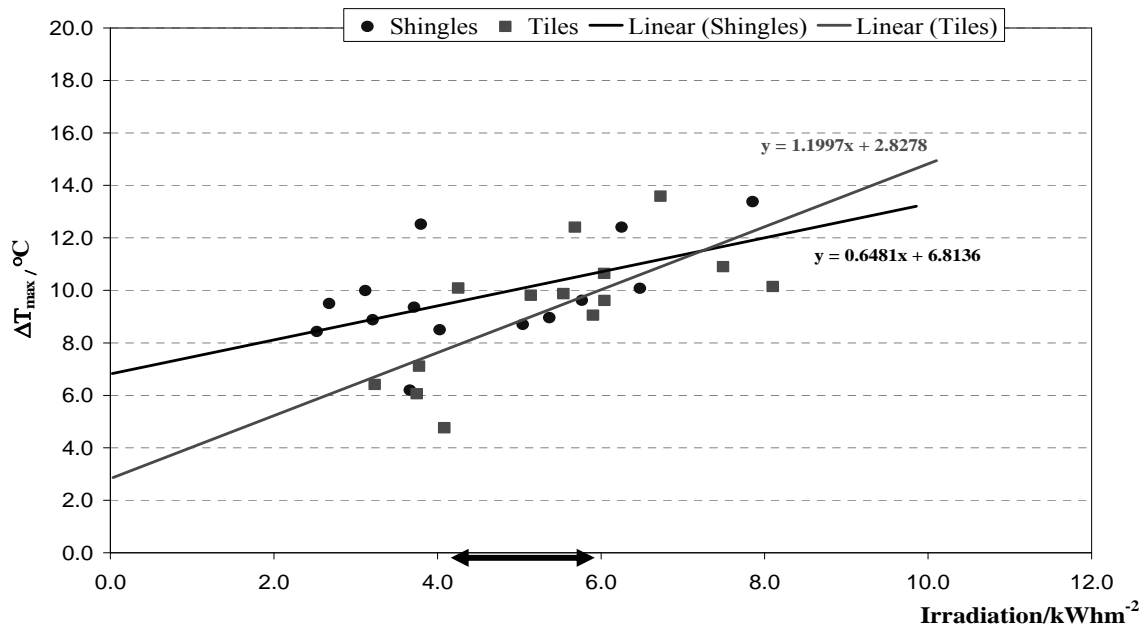
$\Delta T_{max}$  is the difference between the maximum daily internal temperature and the maximum daily external temperature. In Figure 7, the difference in temperature tends to increase with solar irradiation in both instances. The range of scatter indicates that there is a very weak correlation between points. The shingles appear to give a higher internal temperature because of the following factors;

- The surface of the shingles is much darker than that of the tiles hence absorbs and transmits much heat.
- Another fact can be attributed to their masses. The shingles cannot store much heat because of their small mass while the tiles store much more heat.

Though there is a weak correlation in the points plotted above, the range given indicates that the shingles when used as BIPV would increase the internal temperature by about 1 - 2 °C when used in Ghana.

The I-V characteristics for most measured irradiance were plotted (Figure 8). The values obtained for these graphs were collected on separate days since irradiance varied considerably on a daily basis. The open circuit voltage ( $V_{oc}$ ) was 13V, the

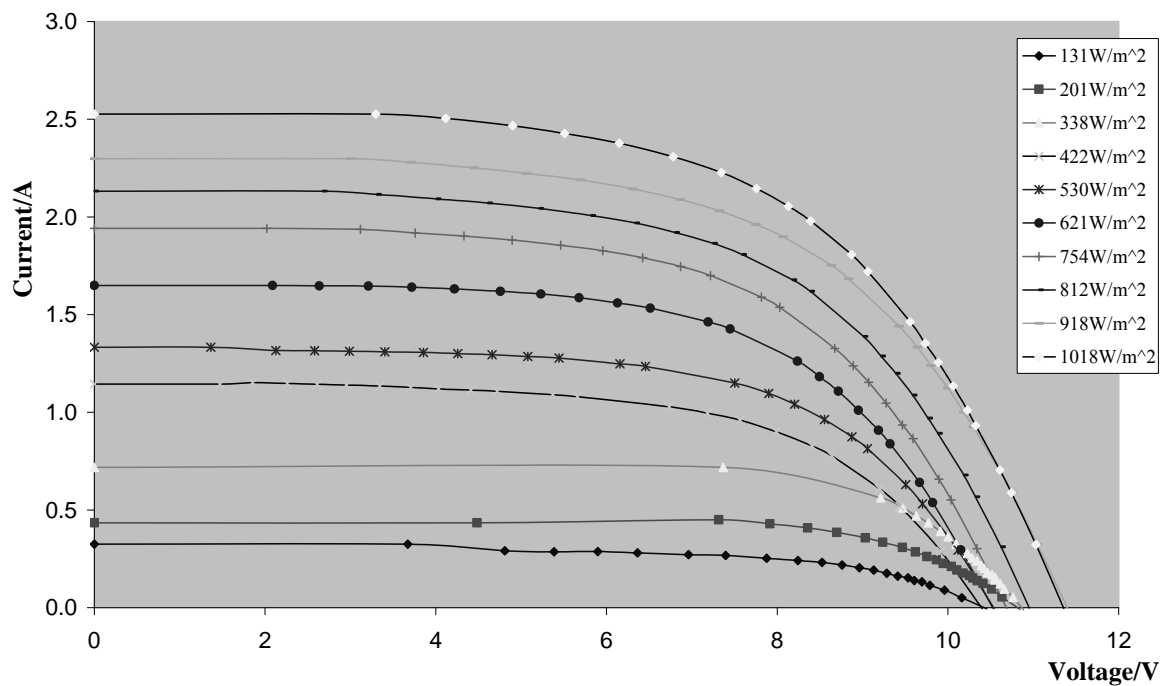
device used was set to 12V because of limitations set on the buffer box. It was interesting to observe that for all levels the curves were quite smooth indicating rapid switching through the resistors so that irradiance would remain almost constant throughout measurements.



**Figure 7:** A graph of temperature difference with irradiation for both roofing sections

## MODULE CHARACTERISTICS

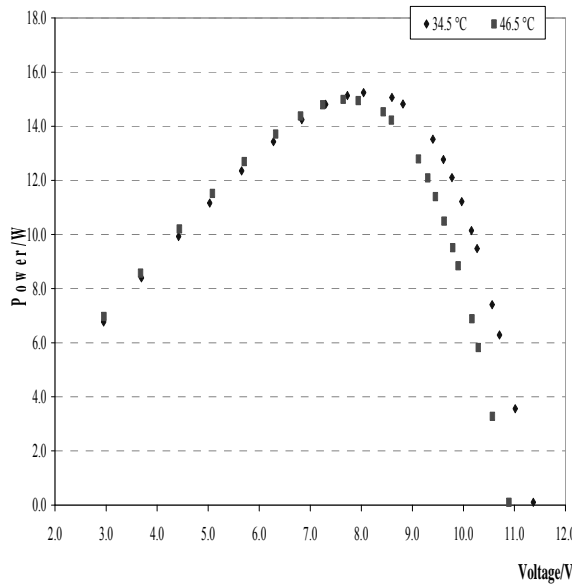
### Effect of Irradiance



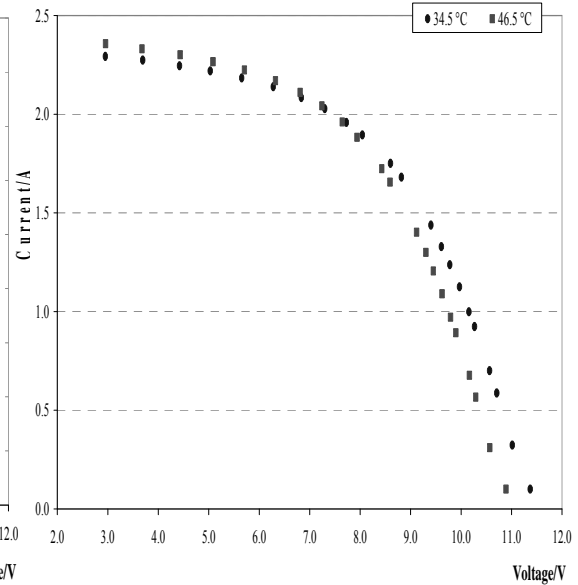
**Figure 8:** A graph of the I-V characteristics of the shingles

## Temperature Effects

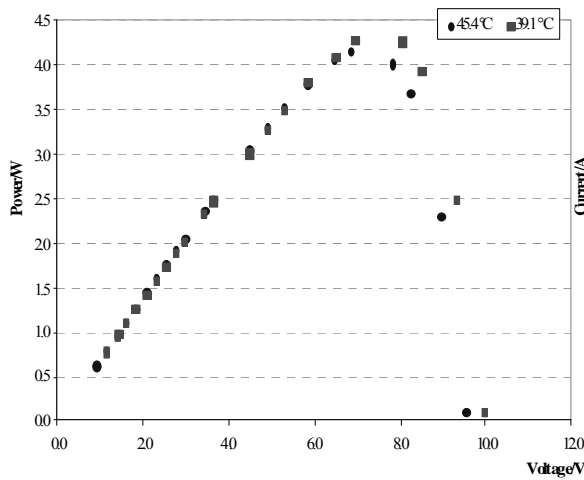
The operating temperature of solar cells in practice can vary over wide ranges for different kinds of photovoltaic modules. Different module design will cause cell encapsulation within them to reach different temperatures under identical operating conditions (Essah, 2002).



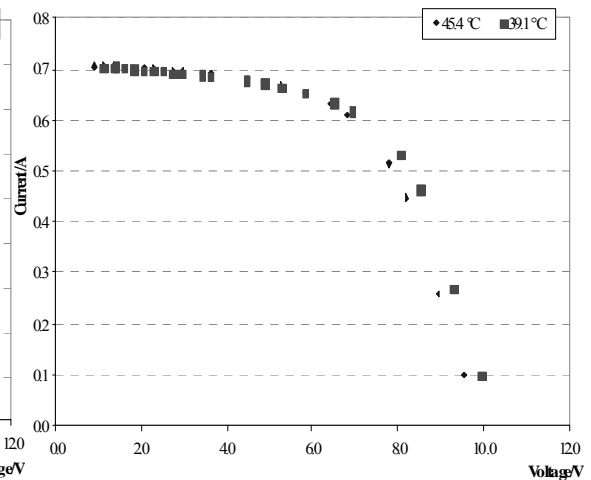
**Figure 9** Effect of temperature on power output of the shingles at high irradiance ( $915 \text{ Wm}^{-2}$ )



**Figure 10** Effect of temperature on I-V characteristics at high irradiance ( $915 \text{ Wm}^{-2}$ )



**Figure 11** Effect of temperature on power output of the shingles at low irradiance ( $248 \text{ Wm}^{-2}$ )



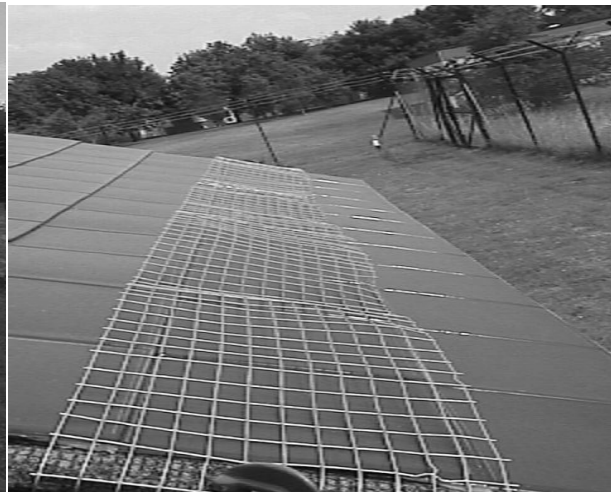
**Figure 12** Effect of temperature on I-V characteristics at low irradiance ( $248 \text{ Wm}^{-2}$ )

## Shading Effect

### a) Triple- Junction Amorphous Silicon (3a-Si) PV



**Figure 13** Shading 3a-Si with battens



**Figure 14** Shading 3a-Si with mesh

The total area of the shingle shaded with battens was about 30% resulting in a power output decline of 35% for both high and low irradiance (Figure 13). Mesh of coarse wires was also used as shading objects (Figure 14). This resulted in 13% of output power loss. This decline is attributed not only to shading from the objects but also to the geometrical position of the sun. The position of the sun is relevant, i.e. if over head or at an angle, a shadow of the shading object is also cast on the PV, which also accounts for some percentage loss. Also the effect of temperature contributes significantly to the total power loss (Table 1).

**Table 1** Comparison of shading and temperature effects at low and high irradiance

Level of Shading	Irradiance ( $\text{Wm}^{-2}$ )	Temperature ( $^{\circ}\text{C}$ )	Percentage of panel receiving light (%)	Maximum Power (W)
Not shaded	275	34	100	4.6
Top third	275	31	65	3
Bottom third	275	32	65	3
Mesh	275	39	87	4
Not shaded	894	42	100	14.8
Top third	894	49	63	9.3
Bottom third	894	44	69	10.2
Not shaded	965	44	100	14.5
Mesh	965	49	84	12.2

### b) Crystalline silicon(c-Si) PV module

For a similar test a polycrystalline silicon PV module was considered. At high irradiance, a comparison of shading effects as in Figures 13 and 14 was configured. For the same percentage of shading used during tests of the 3a-Si, the effect on the c-Si was greatly pronounced (Table 2). Compared with the 3a-Si where at high

irradiance there is a power loss of average 34% when shaded one-third, that of the c-Si is averaged at 55%. This effect is 21% more than the former which reduces the efficiency of the panel significantly. The loss in power output when shaded totally by mesh was equally high (11%) as compared to that of the 3a-Si, which was 4%. Despite the fact that the geometrical position of the sun is a factor in the power reduction, the reason is attributed to the lack of in built by-pass diodes in the c-Si. As a result, shading one cell affects other cells, reducing the power output drastically and hence the efficiency.

Table 2 Comparison of shading and temperature effects

Level of Shading	Irradiance (Wm <sup>-2</sup> )	Temperature (°C)	Percentage of panel receiving light (%)	Maximum Power (W)
Not shaded	750	47	100	42.1
Top third	750	41	46	19.2
Bottom third	750	44	44	18.4
Mesh	750	46	89	37.6

## CONCLUSIONS

The collection and monitoring of data has brought to light the fact that, integrating 3a-Si into the building façade in Ghana, would provide the building a secure roofing material and the supply of electricity. It also avoids high construction cost that may be incurred from some stand alone PV systems. Eventually it helps reduce the environmental impact that would occur from the use of conventional energy.

Triple junction amorphous silicon PV is less affected at high operating temperatures as compared to crystalline silicon(c-Si) PV. However, internal temperatures of the building would increase by some amount of degrees, depending on the surface area of the roof that is covered with the shingles. It tends to cool faster than the conventional roofing tiles therefore reducing the internal temperature during some hours of the day.

It is also less sensitive to shading. Further studies by Essah (2002) confirm that, it works effectively with individual module inverters at all weather conditions as compared to c-Si which comparatively does not work well at lower irradiance. These qualities of the 3a-Si are preferred for the BIPV industry, especially in conditions such as that of Accra, Ghana. Considering the high levels of annual sunshine duration ( 1800 - 3000 hours) in the Sub-Sahara region, the results from this study applies to, and it is of equal importance to countries (such as: Nigeria, Togo, Ivory Coast, etc) in that region. Equally, because all these countries are along the same latitude (above the Equator), the effective angle of the roof (Figure 6) is applicable.

The results demonstrated in this paper confirm the dual significance of the BIPV system to the building in Ghana and more importantly it is adaptive to other neighbouring countries.

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# CHALLENGES AND OPPORTUNITIES FACING CONTRACTORS IN GHANA

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The main aim of this study was to ascertain and discuss the current challenges and opportunities facing construction contractors in Ghana. This involved a review of the economic, legal and political environments in which contractors in Ghana operate; a review of published studies on construction in developing countries generally and Ghana specifically; and in-depth interviews and discussions with seven building and civil engineering contractors in Ghana in 2009 and 2010. Six road contractors were also interviewed. The findings indicate significant challenges relating mainly to financing for projects and a harsh business environment. However, most contractors interviewed admitted to significant problems in their own organisations. It is clear that the contracting environment in Ghana is harsh particularly for local contractors who are often not paid on time and without compensation for late payment. However, local construction firms in Ghana who want to breakthrough ought to formulate the right strategic plans, develop innovative business strategies, develop professionalism, and merge with local firms with similar organisational values and characteristics. In short, local or indigenous Ghanaian contractors ought to face up to the reality of competition and the dynamics of modern business in order to survive, grow and become major players in the construction industry in Ghana.

Keywords: challenges and opportunities, contractor, developing country, Ghana.

## INTRODUCTION

The aim of this study was to ascertain and discuss the current challenges and opportunities facing construction contractors in Ghana. This begins with a review of literature on challenges and opportunities facing contractors in developing countries. Second, a brief description of the economic, legal and political environments in which contractors in Ghana operate is provided. Third, the results of interviews and discussions with seven building and civil engineering contractors and six road contractors in Ghana conducted in 2009 and 2010 are presented and discussed.

## CHALLENGES FACING CONTRACTORS IN DEVELOPING COUNTRIES

The market for major projects in developing countries tends to be dominated by foreign contractors. In a study on contractor development in Nigeria, in which 69 indigenous contractors and 71 professionals responded, Adams (1997) found that major projects in most developing countries are carried out by foreign contractors because of deficiencies in indigenous construction capacity. This was also found in a study of the business environment of contractors in Nigeria by Aniekwu (1995). Using a questionnaire survey covering 11 out of 21 states in Nigeria, Aniekwu (1995) asked

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344 contractors to assess 47 variables relating to the construction industry in Nigeria. Of the 344 respondents, 266 were indigenous contractors (wholly Nigerian-owned) and 78 foreign contractors (either Nigerian branch of a foreign company or Nigerian/foreign joint venture). Although 78% of contractors were indigenous firms, their total share of annual construction work was likely to be significantly lower than the total annual volume of work done by the 22% foreign firms.

Adams (1997) identified the constraints on indigenous contractors' performance in Nigeria as emanating from uncertainties in supplies and prices of materials, obtaining interim payment, procuring work, access to capital, negotiating variation payment, access to plant and equipment, inappropriate contract conditions, maintaining plant and equipment, resolving contract disputes, meeting contract deadlines, design changes, incomplete contract documents, transporting materials and equipment, materials control on site, providing reliable tenders, communicating with client/representatives, shortages of skilled labour, public image, accounting of financial management, inadequate supervision by client, project planning and site management, technical know-how, commitment to construction, company organization, personnel management, providing quality workmanship. Contractors in developing countries have limited access to funding sources, especially contractors in the small-and-medium bracket. One of the biggest consequences of this is that it prevents them from satisfying the financial requirements (e.g. bid and performance bonds) needed to win major contracts often awarded to their foreign counterparts.

The situation in Ghana when it comes to challenges associated with construction in developing countries is not significantly different. Eyiah and Cook (2003) carried out a questionnaire study to identify the financing needs and constraints of contractors in Ghana; determine the extent to which their characteristics influence financing needs and constraints; examine factors contributing to these constraints and the effect on different groups of contractors; and develop guidelines for policy-makers. The research was focused on the experience of the erstwhile Bank for Housing and Construction (BHC) in Ghana which was one of several government owned banks created to provide support for private housing schemes, expansion and modernization of immovable property, estates and industrial construction activities in Ghana. The BHC's financing programme achieved an appreciable level of success initially. However, the level of success later declined as a result of delayed payments to contractors for works completed; contractor's lack of managerial and technical capability to make profit on projects in which they were engaged, or to secure more lucrative ones; inability to obtain contracts; persistent delayed payments by major clients; and the deliberate refusal to repay loans. Despite the underachievement of the BHC's contractor financing programme, Eyiah and Cook (2003) advocated for more but effective financing schemes for local contractors. Other special programmes designed by banks like the Social Security Bank and to help contractors with project financing also failed as a result a number of factors discussed in Eyiah and Cook (2003). These include poor contractors' attitude towards competitive tendering; contractor inability to service equipment loans; lack of spare parts to maintain equipment; poor managerial capacity of contractors; disparity between Ghanaian currency and foreign currency in which cost of equipment was to be repaid; and seizure of equipment from contractors' sites. The BHC's liquidation in 1996 has often been linked to its involvement with contractors.

The literature reviewed in this section of the paper reveals a set of complex challenges facing contractors in developing economies. An article in the April 17-23 2010 edition

of The Economist by Wooldridge (2010) explains some of the current developments, challenges and opportunities associated with innovation in emerging markets. Among the challenges are poor distribution systems, unpredictable income streams, pollution of the environment, infuriating and interfering governments, lack of basic infrastructure and services, and poverty. However, these should be viewed as obstructions and not obstacles to entering and investing construction markets in developing countries. There are opportunities too as indicated by Wooldridge (2010).

## **OPPORTUNITIES FACING CONTRACTORS IN DEVELOPING COUNTRIES**

Nowadays, many multinational firms are moving into developing countries where a lot of markets are emerging (Wooldridge, 2010). Because such countries are mainly developing countries, there is a lot of demand for all types of construction work (Jaselskis and Talukhaba, 1998). A lot of developing countries also have incentive packages designed to attract foreign investment and foreign firms including tax reliefs. In Ghana for example, the Free Zones Act, 1995 was passed *inter alia* to provide incentives such as tax concessions to firms granted licences under the Act.

Corruption has often been touted as a problem in developing countries (Olken, 2009; Olken 2007). However, it may also be an opportunity for firms who have the capacity to bribe government officials to win projects. For example, in 2000, the company now known as Aon Ltd. was censured and fined £300,000 (US \$435,000) by Lloyd's Disciplinary Board in relation to payments, including to government officials, in Ghana, Nigeria and the Philippines in the 1990's (Transparency International 2009 report p.71). The UK Serious Fraud Office in 2009 exposed Mabey and Johnson Ltd, a British construction firm, for overseas corruption practices in Ghana, Jamaica, Bangladesh, Mozambique, Angola and Madagascar. The firm was fined £6.6 million by the Crown Court judge Lord Rivlin. Reparations are also to be paid by the company to the governments of Jamaica and Ghana (<http://www.sfo.gov.uk/>).

In many developing countries, government agencies tend to be are lax and there is not a strict enforcement of laws relating to environment, labour, sustainability, health and safety, etc (Wooldridge, 2010). Therefore, businesses are not likely to incur much overhead of ensuring compliance with environment and labour rules. In short, although the poor institutional structures in developing countries are often criticized, these same deficiencies enable multinational firms to realise high profit margins.

## **THE ECONOMIC, LEGAL AND POLITICAL ENVIRONMENTS OF CONTRACTORS IN GHANA**

Ghana is a major Sub-Saharan African country with a population of 23.5 million people. It has a vibrant and stable multiparty democratic political system of governance particularly in the past 20 years (i.e. since the introduction of the 1992 constitution which ushered in the current Fourth Republic). However, in the past there have been pockets of political instability and a history of coup d'états. For example, between 1966 and 1983, Ghana experienced five successful military coups. To date, there is no research work that explains the impact of politics on the construction industry in Ghana. Therefore it is hard to conclude on the impact of politics in Ghana on the construction industry. Nonetheless, the research work by Jaselskis and Talukhaba (1998) on bidding considerations in developing countries makes it clear that governments in developing countries have a direct influence on construction in both the public and private sector through their behaviour, policies and legislations.

As in many other countries, government is the major construction client in Ghana (Eyiah and Cook, 2003). Hence it is hard to disconnect the impact of government and politics on construction in Ghana. For example, a contractor who is not registered with the government ministries responsible for works and housing or roads and transport will not be entitled to the award of any government project or contract.

In recent years, Ghana has experienced stable patterns of real GDP economic growth rate (2008) of around 7.2%. Further economic growth is predicted particularly with the recent discovery of oil in Ghana (as revealed in a study on links between the growth of the construction industry and the growth of the macro-economy in Ghana by Anaman and Osei-Amponsah, 2007; and another on oil and urban development in Ghana by Obeng-Odoom, 2009 published in the *African Review of Economics and Finance*). As there is a strong link between construction and economic activity (see Hughes and Hillebrandt, 2003 and Calvert, 1995) the projected economic growth in Ghana and the emerging oil industry suggests that demand for construction goods and services will increase in the coming years. Another reason why demand for construction work is likely to increase is that Ghana is a typical developing country (according to the United Nations Human Development Report/Index, 2008) and according to a paper by Jaselskis and Talukhaba (1998: 185) developing countries have great need for almost all types of construction such as highways, roads, hospitals, power plants, dams, housing, maintenance on existing infrastructure, etc. The construction industry in Ghana is an important element of the national economy. The government of Ghana Growth and Poverty Reduction Strategy report (2005) reported that the construction industry contributed 8.8% to GDP in 2003 and 2004, ranking third behind agriculture (35.99%) and government services (9.98%).

The legal system in Ghana (formerly the Gold Coast) is based on English common law and customary law (mainly as a result of British imperialism in the Gold Coast (from the early 1800s) and colonial rule from July 24, 1874 to March 6, 1957). The civil law in force in Ghana is based on the Common Law, doctrines of equity and general statutes which were in force in England in 1874, as modified by subsequent Ordinances. Ghanaian customary law is, however, the basis of most personal, domestic and contractual relationships. Criminal Law is based on the Criminal Procedure Code, 1960, derived from English Criminal Law, and since amended.

## **RESEARCH METHOD**

In order to investigate challenges and opportunities facing contractors in Ghana, it was important to place the contractors themselves at the heart of the study. In Ghana, there are two main categories of contractor. First, there are road contractors who operate with licence from the Ministry of Roads and Highways. And second, there are building and civil engineering contractors who operate with licence from the Ministry of Works and Housing (Eyiah and Cook, 2003 and Dansoh, 2005).

It would have been difficult to undertake a study of this nature without covering both categories of contractor as they both cover a significant share of the construction market in Ghana (according to the registration list of contractors kept by the relevant government ministries). One aim of the study was also to compare findings from the two categories in order to ascertain significant differences and similarities. In all, seven building and civil engineering contractors were engaged in semi-structured interviews. Six road contractors were also interviewed. All interviewees were senior management-level personnel including Technical Managers and Directors. Each contractor was interviewed for more than one hour and notes were recorded in the

course of each interview. All the contractors interviewed are in the top category of classification of firms by their respective government ministries.

## DATA PRESENTATION

Table 1 presents a summary of the interview findings.

Table 1: Summary of major challenges and opportunities facing contractors in Ghana

Building & civil engineering contractors (seven contractors)		Road contractors (six contractors)	
Challenges	Opportunities	Challenges	Opportunities
Finance	Emergence of new oil and gas industry	Finance related - lack of funds; delays in payment; cancellation of advance mobilization; guarantee on government of Ghana projects; cumbersome payment process; limited access to credit	Opportunity to team up for resource pooling
Payment delays	Non-adversarial culture of dispute resolution	Lack of adequate equipment holdings	Diversification into alternative businesses like waste management
Poor design quality	Poor form of consultants	Quarry/aggregates/chippings	Opportunity to learn from the presence of foreign firms
Personnel issues	Lack of vigilance and effective supervision	Lack of adequate supervision of contracts; Technology	
Bribery and corruption	Corrupt officials	Inadequate preparation of projects; Changes in Bill of Quantities	
Poor contractor classification		Presence of foreign contractors	
		Politics	
		Lack of professionalism	

The results of the study are discussed under two broad sections. Section 1 covers building and civil engineering contractors and Section 2 covers road contractors.

### Building and civil engineering contractors: challenges and opportunities

The significant challenges relating to building and civil engineering works related to financial issues, design, contractor classification system, bribery and corruption, personnel and supervision and managerial aspect of contracts. The main opportunities related to the emerging oil and gas industry and perceived growth in the economy.

#### Challenges

**Financial:** The contractors explained that the biggest problem on contracts was payment. Payment-related delays meant that a contractor cannot predict cash flow. The difficulty in predicting cash flows means that banks consider contractors as a higher risk, thus the interest on money to construction firms is higher. Thus, the cost of contractors acquiring capital is high.

**Design:** The contractors indicated that most designs are often inadequate and poorly articulated to enable contractors to clearly understand what to build without several meetings with designers. Drawings do not often have sufficient details. Right from the beginning, the client's requirements are not captured in the tender documents. As a result, there are a lot of variations in the construction phase and naturally that impacts

on cash flow, workflow, and duration/programme. Ultimately, design-related problems impact on profitability of firms.

**Contractor classification:** Many of the contractors explained that those who classify firms do not ensure that firms in the same category have the minimum requirements in practice. This does not create real competition. The interviews indicated that the process of registering construction firms in Ghana needs review. It is important for government ministries to ensure that people who register firms actually possess the personnel, capital and equipment required for classification into a particular category.

**Bribery and corruption:** Bribery and corruption is a big problem for both contractors and consultants in Ghana. Contractors often have to pay kickbacks to the people involved in a project. The total kickback amount was generally expressed around 10%. However, most of the contractors try to negotiate this down to about 5%. In effect, they have accepted it as part of normal business practice and may even build this into the price structure of a job. According to the UK SFO report which indicted Mabey and Johnson (M&J) for corrupt business practices in Ghana and other countries, “The payment of commissions to agents was a routine aspect of the Company’s business, authorised at director level. These payments were structured into the Company’s commercial processes and were factored into contract pricing. Commission fees paid to local agents or middlemen ranged from contract to contract and by jurisdiction. However, historically, it was not atypical for agents to be paid between 5-15% by M&J, although M&J maintain the average was about 8% (Regina vs. Mabey and Johnson limited in the Southwark Crown Court No. T2009 7513). One main problem identified with kick backs is that it affects work quality. Where kickbacks have been paid, contractors tend to use low quality materials to recoup the amount lost and consultants hardly reject the work because of the kickback taken.

**Personnel:** The contractors explained that there was a lack of qualified construction professional with basic knowledge in construction works. There is also a problem with supervision and managerial aspects of construction work in Ghana. Contractors complained that many workmen (artisans) lack the necessary training for carrying out their work. In current practice, “somebody just gets up and says I am a mason”. There are no criteria or qualifications or a barrier to entry into artisanship.

**Workflow:** Some contractors complained about low workload. The volume of construction work has slumped in recent years because of lack on finance and sometimes it takes up to half a year to win a job.

## **Opportunities**

On current opportunities associated with construction in Ghana, most of the contractors said they were optimistic work will increase with the emerging oil and gas market in Ghana. One of the contractors said that “There is construction work associated with the emergence of the new industry, offshore bases. There is real estate associated with the oil and gas industry. There will be a spill over of oil and gas on others industries and sectors of the economy”. One of the contractors said that “Although the industry is competitive, there is not a lot of professionalism so if you have a company with a lot of professionalism, you have a clear advantage over others who are not as equally professional with the way they go about their work. Construction in Ghana at the moment is a growth industry because of the stage we are in our economic development. There is a lot of opportunity for growth for a construction firm that is serious”. Thus, significant opportunities exist with construction work in Ghana which makes it an attractive market for contractors.

**Road contractors: challenges and opportunities**

The discussions with road contractors revealed several challenges and also a few opportunities associated with road construction work in Ghana. The data here relates mainly to the leading indigenous or local contractors in Ghana.

**Challenges**

**Funding:** The main problems expressed by all of the contractors was funding problems which affects the engagement and retention of qualified professional personnel (both administrative – accountants, human resources managers, middle and top level personnel and technical – civil engineers, mechanical engineers, quantity surveyors, artisans and tradesmen – fitters, carpenters, masons, electricians). The contractors said that lack of funding affects equipment also. They do not have the full complement of equipment – most of their equipment is over 20-25 years. This results in frequent and occasional breakdown of the equipment which impedes the progress of work. In some cases, the spare parts are not available to buy, because the machines are obsolete. There are also problems relating to fake spare parts for plan and equipment. Lack of funds also means that staffs are not paid well. Sometimes some contractors do not even have money to pay monthly staff salaries. Sometimes for about eight months a contractor do not get money from any source to pay staff. Because of lack of funds, contractor find it difficult to procure necessary materials like chippings, gravels, bitumen and even water, fuel (gas oil and other lubricants) to carry out works. They go to borrow until they are no longer able to get credit. According to the contractors, the main reason why there is lack of funds is excessive delays in payment by the government – Ministry of Roads and Highways, Ghana Highway Authority, Department of Feeder Roads, Department of Urban Roads. Apart from the Ministry itself, there are other Road Agencies. For example, the Ghana Road Fund (GRF) Secretariat is under the Ministry of Finance and in some way also under the Ministry of Roads and Highways. It is the GRF that pays for road construction works in Ghana and all paper work has to go there before payment can be authorised.

The contractors also complained about lack of access to credit from banks. The main reason for this is that contractors tend to experience unusually long payment delays which make it difficult for banks to calculate when monies will be repaid. Sometimes, for as much as up to eight months, contractors may not be paid on a job although they are supposed to receive monthly payments for work-in-progress. Where banks decide to give a loan, the interest rate tends to be very high. Sometimes by the time a contractor receives a payment, interest rates may have jumped even higher. Some contractors narrated an ongoing practice where in order for banks to be certain that contractors will repay a loan or mobilisation advance, the GRF has to agree in advance with the bank to pay cheques in the joint name of the contractor and the bank. The contractors explained that most of them tend to rely on overdraft facilities rather than bank loans. When they go for bank loans, they often have to provide collateral or guarantee that is difficult for them to provide. One contractor said that “Sometimes you have to use your equipment, often times the equipment might even be under collateral already. So we have to use our house sometimes as collateral”.

**Competitive bidding:** Some contractors also explained that they do not get projects to execute because of competitive bidding. For big jobs, clients often ask for a certain level of turnover – normally around 1m dollars. Sometimes a contractor’s turnover for the previous year may not be up to that turnover so it is not even possible to apply for that job in the first place.

**Equipment:** The interviews with contractors revealed that most contractors do not have equipment and have to hire. In 2005/06 the government of Ghana tried to support contractors through an equipment supply scheme managed by the National Investment Bank (NIB). The equipment was given to about 40 Ghanaian contractors to be paid for in instalments. However the scheme did not quite succeed as some contractors could not pay for the equipment. Not that they did not want to pay, but most of them did not even win any work in the first place to be able to pay for the equipment. Eventually, a lot of the equipment was dormant and depreciated in value without having done any work. The NIB nonetheless chased (and is still chasing) the contractors for the equipment money and the interest rate is accumulating for the contractors.

**Presence of foreign contractors:** the contractors explained that most major projects in Ghana are awarded to foreign contractors. Sometime ago, the Association of Road Contractors (ASROC) Ghana suggested to government that when a job is awarded to a foreign contractor, the firm should be encouraged to sublet about 25% of the work to local contractors with known capability. However, the call has not been heeded by government. ASROC argued that much of the jobs done by staff of the foreign contractors can be done by local experts and professionals. Some contractors complained that there are cases when some expatriates brought in to work for foreign construction firms do not even possess any relevant qualifications in construction.

**Job availability:** The interviews showed a strong relation between job availability and politics. In Ghana, the availability of work and whether a contractor will win a contract is linked to the political regime or party in power. Generally, many contractors in Ghana are perceived to have sympathies for particular political parties. Therefore what happens is that when a particular government comes into power and a particular contractor is perceived as being sympathetic towards an opposition party, that contractor hardly wins any work throughout the time of the new government. One of such contractors interviewed said that “Sometimes the government even gives work to some contractors that are not known to members of the ASROC.”

**Contractor associations:** There are different contractor groups and associations in Ghana. This is not a problem in itself per se because of freedom of association. However, the different groups have different interests so they are not able to speak with one voice about the challenges facing contractors in Ghana. In the past there used to be just one contractors’ association. However, there are now splits and different groups because of disagreements over leadership and constitutional issues.

**Cumbersome payment procedures:** Payment for work done is a very big problem for contractors in Ghana. One reason is that jobs are more than what government can afford to pay. Government is over paying. The main funding for road projects in Ghana come from road tolls, the Consolidated Fund, and donor agencies. The complicated and bureaucratic structure of payment to contractors makes even the release of payment a problem. Even when government has given the approval for payment, Parliament must approve the total amount, before the Ministry of Finance (MOF) will disburse the money, every quarter. Before the MOF disburses the payment, it will ask the contractor to account for monies disbursed for the last quarter to ensure that it has actually completed the work. However, it takes time for the contractor to gather the documentation needed to prepare the accounts and also for the MOF to vet the accounts. For almost the whole of 2008, government had no money available to pay to contractors. The government was forced to borrow money from the Social Security and National Insurance Trust (SSNIT) in order to be able to pay its



debt to contractors. A new government inherited the situation and, as happens in the political climate in Ghana, the new government wanted to understand why and how the debt had accrued. Therefore, there was a temporary freeze on payments to contractors and it took a significant while some contractors were paid.

Between 2004 and 2007 for example, the contractors explained that payment delays ranged between 6-19 months. Discussions with the contractors revealed over 37 processes a contractor has to go through before getting payment. The contractors complained that a certificate could take up to 4-6 months to get through the 37 payment processes. The interviews revealed that most part of the delay occurred around the 'pending payment stage' due to non availability of funds. Even after a certificate has passed through all 37 steps, it may arrive finally at the table and government will have no money to pay for the certificate. In the case of 2007 alone, the total money owed to road contractors in alone in respect of projects was 614 billion cedis or 61,446,957.25 Ghana cedis. And the debt was cleared in 2008 (when government was able to borrow some money from SSNIT).

**Politics:** Contractors expressed frustration with the contracting environment in Ghana and the politics that often surrounds it. The contractors complained that the business environment is driven by politics. Each government that comes into power tries to propel its own set of contractors because they realise that contractors are a very good source of raising money for financing political campaigns. In short, most contractors complained that "Politics is a major problem". One contractor mentioned that foreign contractors, for example, are not members of any of the local contractor associations in Ghana because they have been advised by their home governments to stay out of the political atmosphere in Ghana for sustainable business.

**Contractor capacity:** Low capacity of indigenous Ghanaian contractor was identified as a major problem. Some contractors said that the World Bank was trying to help in addressing it through a series of training programmes and workshops for contractors. One contractor explained that "Competition is good. We should encourage competition. However, it is the business environment that is competitive. Everybody who is interested in doing the job has to show their capacity. The low capacity of the local contractors makes it difficult for us to compete."

**Access to credit:** Most Ghanaian contractors fall within the SME bracket and always have to go and look for credit. The cost of credit is high. Most contractors in the SME bracket could not afford equipment. These contractors said that it was government's duty to create an environment which ensures that businesses can thrive and grow. They were certain that "Government can help". The contractors complained that the current business environment is not one that is capable of helping them to build their capacity.

Other challenges identified through the interviews included technology and lack of barriers to entry into the market. In the words of one contractor, "This is the only industry in the country where everyone can get up and say I am a mason, I am a carpenter, etc. Government should set up a school to train all the artisans. Currently we train our own people through apprenticeships. There is a wide range of problems facing us."

### **Opportunities**

Despite the numerous challenges, some contractors suggested opportunities that could be pursued to develop their capacity and business. One contractor said "As

contractors, we can team up to buy equipment. But there is a problem with the history of partnerships in this country. People cannot be trusted. That is the problem. People do not approach partnerships in a business sense. Considerations of friendship and family are too much in our social setting, which ultimately affects business. There is a problem with attitudes. But it is the nature of our society. The kind of aspirations that society places upon us does not help us. If you are a contractor and your family members hear that you have won a project, everyone will expect you to help them out of their personal financial difficulties. There are a number of opportunities that contractors can tap. But our attitudes and the system in Ghana is a problem.”

Some contractors complained that the contracting environment and business in Ghana is stifled and not growing. However, some of them said it provided contractors with an opportunity to diversify into other areas where they can make higher profits.

One contractor said that a Ghanaian contractor who wants to increase and build their capacity should approach foreign firms who might like to sublet some of their work. This would help the local contractor in developing capacity and learning and transferring knowledge. One contractor explained that “Chinese firms in Ghana don’t give work to local contractors in Ghana because the Chinese work 24hours and Ghanaians work just 5hours. We are running our economy on an 8-hour basis while people in advanced countries run theirs on 24hrs so naturally we cannot compete. If we don’t increase production how can we grow the economy? We have to move a step further. Collectively we have a long way to go.” therefore, there is a lot of opportunity for the contractor who is serious in developing a professional approach to business.

One contractor said that “The concept of entrepreneurship should be applied by contractors in Ghana. If you look at the way a lot of our contractors operate, you would see that there is no real planning for business. Contractors must be trained to manage their business. Unfortunately in Ghana, anyone can just get up and say that they are a contractor. What we need to do is to take a comprehensive step/package to help us address the problems and that takes a bit of time”.

## CONCLUSION

The aim of this study was to ascertain challenges and opportunities of construction contractors in Ghana. Seven building and civil engineering contractors were interviewed. Six road contractors were also interviewed. The findings reveal a huge number of challenges but also some opportunities for contractors in Ghana. The emerging oil industry presents fresh opportunities for construction work and development of infrastructure. There is also a culture where cases and disputes on projects tend to be resolved through arbitration and mediation rather than litigation where contractors may lose a lot of money. Another big opportunity on construction contracts is that consultants are sometimes not very confident of their professional abilities and estimates and sometimes tend to overvalue work or pay quantities provided in bills of quantities without measuring the actual work done on site. This helps some contractors to make money. There is also almost no penalty for delay and shortcomings on contracts especially because clients also tend to default on their responsibilities. Thus, because of poor form of some consultants and the absence of many competitive firms, there is significant opportunity for a serious contractor.

The main challenges were related to financial, political, organisational and the economic factors. The significant similarity in the challenges facing both category of contractor is the funding or payment problem. For road contractors, this is a bigger problem because government tends to be their major and only client. But for building

and civil engineering contractors, there are private clients who have the ability to pay certificates promptly. Therefore, a building or road contractor who has sufficient private sector jobs can opt out of government projects and still survive in the contracting business. However, this cannot be the case for road contractors as all roads are constructed by the government. Both category of contractors agreed that there are opportunities associated with contracting in Ghana. For the building and civil engineering contractors, significant opportunities are anticipated with the emerging oil and gas industry. Road contractors would also have opportunities with this although none of them mentioned it directly. Both category of contractors agreed that most local contractors in Ghana lack strong organisational, managerial and financial capacity. This was attributed as one main reason preventing them from competing against foreign contractors. Contractor associations like ASROC have called on the government of Ghana to allocate a percentage of public projects to local contractors, even when the project is awarded to a foreign contractor. However, this may not be a viable call in practice. Local construction firms ought to be competitive and win work on meritorious rather than nationalistic reasons. Most contractors interviewed admitted to significant organisational problems that they needed to sort out in order to become competitive. It is clear that the contracting environment in Ghana is harsh particularly for local contractors who are often not paid on time and without compensation for late payment. However, local construction firms in Ghana who want to breakthrough ought to formulate the right strategic plans, develop professionalism, and seek mergers with other local firms with similar organisational values and characteristics. In short, local or indigenous Ghanaian contractors ought to face up to the reality of competition and the dynamics of modern business in order to survive, grow and become major players in the construction industry in Ghana.

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# CHARACTERISTICS OF MIGRANT LABOUR IN WASIMI, IREWOLE LOCAL GOVERNMENT AREA, OSUN STATE, SOUTH-WESTERN NIGERIA

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Areas known to be rich in agricultural production have over the years been known to attract a stream of migrant labour who have taken advantage of the rich alluvial soils to transform their lives and that of their immediate milieu. The study examines the characteristics of migrant labour and assesses the potentials of the study area which make it attractive to them. Data for the study was collected from both primary and secondary sources. The primary data was collected through systematic random sampling of ten percent of the total households. Secondary data obtained from topographical maps on a scale of 1:50,000 and satellite images: Landsat ETM+(2002) from archival sources was processed using the ILWIS software. Primary data was analyzed using descriptive statistics. The results showed that 69 % of the respondents had no formal education, 94.5 % made use of rudimentary tools such as hoes and cutlasses typical characteristics of rural migrant labour. From the study we can draw the curtains on the fact that rural migrant labour are agents of change and innovation diffusion, contributing to the transformation of the rural areas from food deficiency to food sufficiency with excess for export.

Keywords: migrant labour, GIS, poverty, environmental management and planning.

## INTRODUCTION

Migration is the movement of people, individually or collectively, from one geographical region to another, temporarily or permanently. It is a very dynamic and complex phenomenon. It has, therefore, continued to occupy the centre stage of all human discussions as a result of the far-reaching consequences on both the departing and receiving communities. Human population movement is not new as it predates human origin when early man wondered in search of the basic necessities of life such as shelter, food and water.

What is striking and new about human population movement is the unprecedented scale they have reached in recent times. UNHCR (1995) observed that at moment, in addition to the hundreds of millions of economic migrants, there are some 18 million refugees on international transit, with 35 million people internally displaced, 100 million uprooted by planned development, and an estimated 25 million in danger of displacement as a consequence of environmental change (McDowell 1996). Food and Agriculture Organisation (FAO 2007) reported that in the past 50 years, over 800 million people have moved from the rural areas into the cities. Amongst other reasons for such movements are: population pressure, scarce land, decreased agricultural

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productivity and lack of wage-earning opportunities. Findley, 1997 in a related study on migration in Africa observed that one in every five Africans is no longer living in his or her place-birth. Nigerians are very mobile people and it will however not be exaggerated to say that one out of every five black persons any where in the world is a Nigerian.

One of the major challenges in migration studies in Nigeria, particularly rural – rural migration, is the dearth of information on such studies as most studies have concentrated on rural-urban migration. This study, therefore, is set to seek information or set to answer research questions on why do people move from one rural area to the other? What are socio-economic characteristics of rural migrants? What can they really do when they get there in order to bridge this gap? What can be done to make them stay where they are?

This study therefore had as objectives to examine the characteristics of migrant labour and also assess the potentials of the study area which makes it attractive to migrant labour with a view to alleviating poverty and to serve as a guide to planning and the decision making process.

## **THEORETICAL FRAMEWORK**

Rural – Rural migrations studies, and are not very common in Nigeria as emphasis has been on rural – urban migration. However a few studies highlighted some issues on it: Fadayomi (1998) revealed a general persistence of rural – urban and rural – rural migration in Nigeria. William (1970) identified factors which could send one off a place to include: crisis, transfer, retirement and invasion by disease and pest. The economic motive of employment and higher income appear to be the dominant factor of rural – rural and rural –urban migration. Makinwa (1981) while commenting on the characteristics of migrants observed that about 70% of rural– urban migrants are usually young, educated (and mostly males while rural – rural migrants are often older, uneducated, married males with dependants. Primavera (2005) while commenting on the characteristics of rural migrants observed that they make use of rudimentary tools. Singh and Kalala (1994) reported that in order to supplement household incomes, poor pastoral households in Borana were accustomed to seasonal migration to salt mines at Soda and gold mines at Kebre Mengist and Awash valley to harvest cotton and maize. Oucho (1984) observed an innovation in Kericho Tea Estates complex of Kenya where the colonial administration, ushered in dramatic movement from traditional economies in rural areas, to the mobilized peripheries or “economic islands” such as tea, coffee, sisal and sugar plantations.

Principally, migration comes about as a result of push factors which send away the migrant from their place of birth and the pull factors which attract the migrants (Primavera, 2005). Some theories have been propounded in an attempt to rationally explain why people move whose contributions are germane to this present study amongst others include: Todaro (1969); Mobogunje (1970) and Byerlee (1974).

Todaro’s model on human capital theory of migration observed that migration is a personal decision that will only be made if the returns for this behaviour are justified (Todaro, 1969). The next model explaining migration in Africa is the systems model by Mabogunje which states that rural/urban migration is controlled by systematic interrelationships or rural/ urban control systems, rural /urban adjustment mechanisms and the positive or negative flow of information about migration. Mabogunje’s model considers the pool of potential migrants in the rural areas as a mass resource rather

than as individuals, and that there is a backward economy characterized by: social and economic conditions, government, politics, transportation and communication infrastructure (Mabogunje, 1970). The third model by Byerlee (1974) considers economic migration as the outcome of cost return calculation. Byerlee posited further that this model goes beyond cost return analysis of human capital approach and included elements of the social system, explicitly identifying determinants of rural and urban incomes and introducing risks and other psychic costs to be included in the migration decision-making process (Byerlee 1974, Arthur, 1991). Generally, we can conclude that human capital returns, systems approach and cost returns are very relevant to the present study as most migrants move because they expect to make a better living in their new places which may not always be the case.

### **Migrant labour**

The importance of migrant labour to the socio-economic development of rural areas of Nigeria cannot be overemphasized. Southwestern Nigeria is the main area for commercial cropping of cocoa for export in the country. This region is also known to produce the highest number of scholars in the country. Hence, most educated youths have been known to have migrated to the cities in search of greener pastures thereby causing serious shortage of labour on these farms which have been the major limiting factor for the expansion of commercial agriculture. The employment gap created by rural-urban migration has been filled by rural migrants from areas of relatively low population densities of 150 persons per km<sup>2</sup> (Udo, 1971). Most of the migrants are either engaged as wage-earners on the commercial cocoa farms or as share-croppers or both or independent self employed tenant farmers who cultivate staple food crops and commercial crops (Udo, 1975).

The single largest group of seasonal migrants into the cocoa belt consists of Hausas from the far northern part of Nigeria that comes in between October and February and leaves by March. The significance of this is that this period corresponds to the off-farming season in northern Nigeria. The second group of migrants is more permanent as they have settled for years and have gone through a lot of transformation from labour workers, to share-croppers, to self employed tenant farmers amongst who include: Ibo, Igbira, Isoko and Urhobo (Udo, 1975).

Migrant labour contribution especially in food crop production has been greatly felt in Osun State especially in the Odeomu area where Igbira migrant co-tenants have succeeded in turning the district from a food deficit area to one which now exports such food stuffs as garri, plantain and yam to Ife, Osogbo, Ibadan and Gbongan (Udo, 1975). Ajaegbu, (1975) in a related study also identified the roles of rural migrants in land use transformation and development process of the rural economy. Rural migration raises a lot of hopes as the income of migrants sent home in the form of remittances can increase food security, help diversify livelihoods and incomes, and reduce the vulnerability associated with shocks (FAO, 2007) and Primavera (2005).

### **RESEARCH AREA**

The study was conducted in Wasimi wetlands in Ikire, Irewole Local Government Area of Osun State, South-western Nigeria. This area is located between Longitudes 04° 13' 00" and 4° 18' 00" E and Latitudes 07° 24' and 7° 29° 00', N covering a surface area of about 84.75 km<sup>2</sup>. The area is very low-lying, forming a basin-like structure which makes it to retain enough water for cultivation in both the wet and dry seasons. The climate of this area could be identified as humid tropical characterized

by marked wet and dry seasons, typical of southwestern Nigeria. The wet season covers a period of seven to nine months with double rainfall maxima in July and September. The mean annual rainfall recorded at the meteorological station Osogbo is 1196 mm (Smyth and Montgomery, 1962, Jeje, 1974). Monthly temperatures are generally between 23°C and 27°C and relative humidity ranges between 67% and 88% (Smyth and Montgomery, 1962). The soils are associated with the Iwo and Egbeda associations in the Ikire-Gbogan area, rich in alluvial deposits derived from the rivers draining the area (Shasha and Osun Rivers). The vegetation is far from being a rainforest though located within the tropical forest belt, as it has been modified or cleared to give way for crop cultivation which is the dominant economic activity. The present vegetation can, therefore, be described as a mosaic of derived savanna dotted with trees and palm trees - a dominant economic tree for palm oil production. Wasimi is typically an agrarian economy with a few commercial outlets. Migrant labour grows both food and tree crops in large quantities. The food crops are: rice, maize, tomatoes, pepper, cassava and yam amongst others while the tree crops include: cocoa and oil palms. Animal production, especially cattle and goat rearing, piggery, poultry and fish farming are also gaining prominence.

The Igbara community from Kogi State, which constitutes more than 90% of migrant labour in Wasimi, are traditional farmers who are being pushed out of their own environment by the rugged terrain which is devoid of any meaningful agricultural activities. Other push factors include: inter-communal crisis amongst themselves within the sub-region and poverty. On the other hand, the zeal to improve on oneself, the rich alluvial soils, and the hospitality exhibited by the Yorubas as the host community all serve as pull factors which identify with earlier works by McDowell 1996, FAO 2007, Findley, 1997, Fadayomi, 1998 and William 1970.

## **RESEARCH METHOD**

The data used for the study were collected from both primary and secondary sources. The primary data consisted of structured questionnaires, photographs and GPS recorded information. Structured questionnaires covering a wide range of spatial, economic, social and environmental issues to assess the poverty situation of the area were administered on the household heads covering about 10 % of the population of Wasimi. Households in the survey were chosen in a systematic random manner where the first household was chosen randomly and the next being the 10th household in that order along major lines of communication routes. Out of 210 questionnaires administered only 121 were returned for analysis. Information on infrastructures like roads and social facilities like solid waste disposal, health and schools were obtained from observation and oral interview by the researcher during visits to such establishments. Other data were gotten from visits to farms. The data analyses adopted made use of the simple descriptive statistics. The satellite image Enhanced Thematic Mapper (ETM+) from the archival sources was digitized based on the visual interpretation and classification into the identified land use features, polygonised and incorporated into the database for GIS analysis.

## **RESULTS AND DISCUSSION**

The classification results showed that vegetation covers about 46476945.0 hectares, cultivation 23364371.3 hectares, wetlands 5208959.3 hectares, water bodies 1423062.0 hectares and settlement area cover 8247586.5 hectares which shows that there is enough land for commercial agricultural development.



### Education and household characteristics

The results revealed that 69 % migrant farmers have no formal education while about 13.4% were primary school leavers, 7.9% had secondary school Education, 2.6% were NCE/OND graduates and 2.6% had the first degree. This is a typical characteristic of migrant labour which is in line with earlier studies by Udo, 1971; Makinwa, 1981 and Fadyomi, 1988. Furthermore, the results showed that 34% of the respondents had a family size of 5-7 and 24 % had a family size of above 10 children (table 1) showing a heavy family burden, though they are used as farm labour, typical of rural Africa.

### Socio-economic characteristics

Table 1: Socio-economic characteristics of respondents

Economic Activity	Frequency	Percent	Farm Tools	Frequency	Percent
Farming	94	75	Hoes and Cutlasses	120	94.5
Mixed occupation	17	13.4	Others	1	0.5
Trading	10	6.9	Total	121	95.3
Total	121	95.3			
Origin	Frequency	Percent	Source of Water	Frequency	Percent
Yoruba	56	44.1	Flood water	102	80.3
Non-Yoruba	58	45.7	Local well	12	9.9
Other Nationals	7	5.5	River channelling	5	3.9
Total	121	95.3	Borehole	1	.8
			Other specify	1	.8
Distance to Farm	Frequency	Percent	Total	112	85.7
Less than 1km	33	26.0	Education	Frequency	Percent
1 – 2 Km	40	31.5	No formal Education	90	69.0
3 - 4 Km	31	24.4	Primary School	12	13.9
5 - 6 Km	15	11.8	Secondary Certificate	8	7.9
7 - 8 Km	1	.8	OND/NCE	5	2.6
Above 9 Km	1	.8	First degree	5	2.6
Total	121	95.3	Total	121	95.3

The results in Table 1 show that 75% of the respondents were farmers, 13.4 % with mixed occupation and 6.9 % traders. This is another characteristic of rural areas which conforms to studies by Udo, 1975. The study revealed that 20 % of the population earned 30.7 % of their income during the dry season. The results further indicate that 50 % of farmers earn up to 80 % of their income in the wet season. Similarly, 80 % of respondents depend on flood waters for the wetting of their farms in the dry season, indicating that the area has potentials for all year round farming - an attribute which could reduce poverty. Over 79.6 % owned more than two farming, plots of 2 hectares and above which points to the fact that the farms are in small holdings which makes mechanization difficult. Similarly, 54.9 % of the farming plots were rented or leased to the migrant farmers from Kogi and Benue States a consequence of the push and pull factors of migration as exemplified in the works of Todaro (1969); William (1970); Mobogunje (1970); Udo (1971); and Byerlee (1974) and Primavera (2005). Up to 94.5 % of farmers make use of basic tools such as hoes and cutlasses a common feature of subsistence farming as observed in a similar study in Ghana (Primavera, 2005).

### House/living environmental characteristics

The results show that a bulk of the houses were constructed in the 60s (33.1 %) during the cocoa bounty harvest and 70s (30.7 %) during the oil boom periods (table 2). About 51.2 % of the people are living in rented apartments, with 26.0 % living in two-room houses, 22 % in one-room and 17.3 % in three-room houses respectively. This is a typical characteristic of migrants observed by Makinwa 1981. In the case of the extended family structure, there is a high indication that most of the houses are overcrowded (table 2). The roofing materials were dominated by corrugated iron sheets 85.8% with 74 % of them having no ceiling (table 2). In like manner, 60 % of the houses had cemented floors with unplastered walls, 39 % of the walls were in a fair state, 31.5 % in a good state, and 19.7 % in poor condition and even the houses in fair state needed urgent maintenance. All of these are all indices of poverty and environmental degradation (Table 2).

Table 2: House/living environment characteristics

Owner of Residence	Freq.	Percent	Ceiling Materials	Freq.	Percent
Family	27	21.3	No Ceiling	94	74.0
Built by self	21	16.5	Local Ceiling	11	8.7
Rented	65	51.2	Modern Ceiling	16	12.6
Other specify	8	6.3	Total	121	95.3
Total	121	95.3	Daily Power failure	Frequency	Percent
No of Rooms			Once	11	8.7
1	29	22.8	2 – 4	28	22.0
2	33	26.0	5 – 7	32	25.2
3	22	17.3	8 – 10	29	22.8
4	14	11.0	Over 13 times	20	16.5
5	11	9.0	Total	101	95.2
Above six	12	9.4	Power Supply	Frequency	Percent
Total	117	92	1 – 3	29	23.9
Roofing Materials			4 – 6	64	52.5
Zinc	109	85.8	7 - 8	14	11.8
Thatch	6	4.7	others	8	6.3
Tarpaulin	3	2.4	Total	121	94.2
Asphalt	1	.8	Alternative power	Frequency	Percent
Total	119	93.7	Bush Lamp	38	29.9
Floor Material			Lantern	71	55.9
Bare ground	29	22.8	Generator	12	9.4
Cement/Sand	77	60.6	Total	121	95.3
Concrete	15	12.4			
Total	115	95.3			

### CONCLUSION

From the characteristics of migrant labour it is clear that about 70% of them had no formal education and are mostly involved in small scale food-farming. Wasimi as Odeomu, where Igbira migrant tenant farmers who migrated from Kogi State have taken advantage of fertile alluvial soils to transform their immediate milieus from food deficient areas into food sufficient areas. The excess food is exported to neighbouring communities, is a right step in the right direction that needs to be encouraged.

Travellers to Ibadan or Ile-Ife stop over to buy tomatoes, yam, plantain, garri and

other food stuffs at Wasimi. The migrant farmers plant maize up to three times a year, yam two times a year and tomatoes throughout the year. Rural migrant labour has, therefore, been identified as agents of change and innovation diffusion in Wasimi and other rural areas of Nigeria. If these resources are sustainably managed, the biting, dehumanizing and defacing incidence of poverty in the rural areas like Wasimi could be reduced.

## **RECOMMENDATIONS**

The following recommendations were made from the study.

- 1) The National FADAMA Programme with facilities for small and medium size credit scheme is a welcome development and farmers in Wasimi should take advantage of them to maximize their potentials. This will enable the farmers to move out of small scale farming into mini/large scale commercial farming with added value for growth and development.
- 2) The use of machines for agricultural production will go a long way to increasing food production, increasing their earnings and move them out of poverty.
- 3) Potable water supply, electricity, roads and other infrastructural facilities should be provided to stimulate rural development. In this light a multipurpose dam should be constructed in the area: for domestic water consumption, power generation and commercial agricultural production since the area is blessed with numerous water resources. This could go a long way to reducing rural-migration and thereby boost irrigation farming system activities.
- 4) For effective poverty eradication in the study area which is one of the Millennium Development Goals (MDGs), rural development and agriculture should be given a greater attention by the various Government arms since it is the main stay of the economy of the people.
- 5) Remote sensing and GIS should be made an integral part of decision support system for natural resources management so as to promote sustainable development and maximize resource use to aid planning and decision making.

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# CONSTRUCTION CASH FLOW PREDICTION MODEL IN GHANA: A CASE STUDY OF THE DISTRICT ASSEMBLY COMMON FUNDED PROJECT

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When planning the short-term or long-term funding requirements of a business, it is more important to forecast the likely cash requirements than to project profitability. Cash is important for the day-to-day existence of a company and some contractors have suffered a downfall not because their work was not profitable but due to lack of cash in the short run. The aim of this research is to develop a model for predicting construction cash flow in Ghana with the DACF as a case study. Analysis of data gathered through structured questionnaires from 30 district assemblies, 22 consultants and 71 contractors revealed that delays in honouring certificate, effective margins, retention conditions, pricing strategies, quality of measurement and retention conditions are the most significant factors affecting the cash flow of construction firms in Ghana. These factors were categorized into under 3 generic groups: monetary, semi monetary and schedule related factors. Through significant testing, 18 of these factors were selected and categorized as monetary, semi monetary and schedule related factors as a basis of developing the model. A four phase quadrilateral conceptual model was proposed as a basis for developing an implemented model, a one phase quadrilateral model to predict short-term cash requirements for construction projects in Ghana. This paper proposes an automated cash flow model depending on 15 factors for predicting construction cash flow in Ghana to serve as a planning guide in the built environment.

Keywords: cash flow, project parameter, current asset.

## INTRODUCTION

Cash flow, a distribution of income and expenditure as a function of time, deduces its importance as a tool for compiling, forecasting, exploring and assessing possible funding requirements and the likely financial consequence to develop alternative strategies. Its empirical role as a tool for planning in advance cannot be overemphasized as it is used in preventing major planning errors, anticipated problems, identify opportunities to improve cash flow and provide a basis for negotiating short term funding from financial institutions. Park *et al.* (2005) quoted Singh *et al.* (1992) that cash is the most important of a construction company's resources. Whilst profit, the positive difference between sales and costs within a specified period, is a vital indicator of the performance of a business, the generation of profit does not necessarily guarantee its development, or even survival. It is

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imperative to note that more businesses fail for lack of cash flow than for want of profit. Most contractors working on construction projects suffer serious liquidity and cash flow problems. Park *et al.* (2005) quoted Russell (1991) that more than 60% of construction contractor's failure is due to economic factors. The effects of the above challenge results in undue delay in project completion with its rippling effect of construction cost and time overruns. The above situation is compounded when such contracts are fixed price in nature without fluctuation as part of the contract Danso et al (2009) quoted Aheng (1999) that at least 25% of projects implemented under the district assembly common Fund (DAF) could not be completed on time due to delays in payment. On the contrary, Baiden-Amissah (2000) at 5% level of significance, using 95% confidence limit showed that all projects undertaken in the Ashanti region of Ghana suffered delays due to payment challenges, stating that some contractors suffered at least six months delay before their certificates are honoured.

The high risk and capital expenditure associated with the construction process necessitates that the economies of the contractor be studied before the project commences to forecast his financial requirement along the entire construction trajectory to prevent the possible lock up of contractors' capital. For the many industries operating, the construction industry is one highly characterized by the problem of cash flow and availability of current asset and inventories. Most financial institution's unwillingness to give loans to construction firms is due to the long-term debt conversion period. Cash flow models have been developed over the years either using a mathematical function or computer software to predict the liquidity pattern of a given projects. Studies on accurate cash flow models based on ideal values have produced conflicting results (Navon, 1995). The feasibility of building ideal value curves for different project types is questionable since project characteristics vary. Most construction experts have declined cash flow estimation due to the ambiguous arithmetic and mathematical calculations associated with it.

Most project managers and site engineers are however deterred by developing detailed and accurate cash flow whether due to lack of time or knowledge or because of the amount of manual work involved, even when there is software available. Hohoabu (2005), after a series of studies on construction cash flow prediction in Ghana observed through data gathered that only 17% of sampled consultant actually engage in cash flow prediction, some other 41 ½ % indicated that they hardly undertake cash flow prediction, the remaining 41 ½ % indicated that they never undertake cash flow prediction. The above could be due to the rigorous arithmetic one goes through when undertaking cash flow analysis. Probably rigorous arithmetic calculations associated with cash flow analysis coupled with the non-availability of an automated cash flow model with peculiar characteristics has resulted in the above, hence this study.

## **IMPORTANCE OF CASH FLOW FORECASTING AND MANAGEMENT**

Xueqing (2005) after study the critical success factors of infrastructural projects stated that most projects are abandoned at just 30% completion way with just a few going through to completion thus meeting the stipulated contract duration and project characteristics. Chen et al (2007) stated that cash flow is the life of a business. During periods of inflation, poor cash flow can lead to reduced profit, which in turn can produce a rippling effect on shareholders return (Ashworth, 1995). An accurate cash flow management system is crucial for the survival of a construction firm because cash is one of the most important corporate resource and current asset for the day-to-

day activities of a firm. In summary, cash flow forecasting is required for a number of purposes such as early price estimating, setting of budgets and targets, analysis of future financial position of the firm and final accounting predictions and life cycle costing.

The major sources of income to all contractors who undertake construction project are interim valuations and related claims. Other sources of cash inflow to retained earnings and profits, loan and credit arrangement with financial institutions. Contractors need regular cash inflow for acquire labour, materials and plats. Many factors affect the contractor's cash flow hence dictating the shape of the S-Curve. All factors affecting the contractor's cash inflow and outflow to some extent affect the shape of the S curve both directly and indirectly. According to Kaka (1995), over fifty (50) factors affect the cash flow of the contractor. At or before certification, a couple of such factors determine the contractor's possible cash inflow and out flow. These factors include time interval between valuation, rate of retention, retention limit, availability of creditors, period of honouring certificate, time interval between incurring a cost liability and payment, material on site, pricing strategy, margins and mark-up, related claims, etc (Peers, 1992; Singh and Lankenathan, 1992).

## **LITERATURE REVIEW**

Kenlly Wilson, Patchell et al (1990) presented the use of the DHSS formula to 27 completed construction projects. Based on the above, a multi-linear regression with project value, duration, type dependent variables is shown not to produce any significant improvements on the standard DHSS. The major demerit of the above formulae is the tedious calculation and logarithmic functions; one would have to go through before deducing cash flow figures coupled with the number of assumptions and considerations to make. To enhance the relationship between cost items and schedule, Seers (1991) developed the manual integration of cost items and schedule. In this model, the integration of the cost item and schedule is done by compiling for each project, a table or file that reflect the relationship between activities and cost items. This model has its accuracy due to forecast based on resource, but it is achieved at the expense of manual work and it ignores the time lapse between resource and payment, which made construction professionals deter its use as a cash flow forecasting tool.

Kaka (1995), sought to introduce the effect of risk on the cash flow of the contractor which enables the evaluation of certain factors such as variances between actual and budgeted cost and quantity variance on cash flow. The model was designed using more than fifty (50) variables to calculate cash flow of individual contracts by introducing stochastic simulation with extra variables that contribute towards risk. According to Kaka, since construction is a risky business, a reasonable amount of data entry (eg the shape of the S-curve, actual profit to be received each month, under/over measurements, etc) required to forecast cash flow cannot be determined precisely. Consequently, contractors must evaluate the effect of this imprecise information on their cash flow; which will help them plan their cash flow requirement accordingly.

On the Ghanaian front, Hohoabu (2005), after studying 400 projects in Ghana with respect to payment certification developed a mathematical model to guide construction client, contractors and consultants, predict cash flow pattern on projects. Two equation relating proportions of expenditure to proportion of times were developed as

$$Y = \frac{2.658x^3}{10^5} - 0.003868x^2 + 1.121x, \text{ for road projects and}$$

$$Y = \frac{1.59x^3}{10^5} - 0.003x^2 + 1.141x, \text{ for building projects in Ghana.}$$

Where Y is the cash flow at period x. The use of the formulae presupposes the existence of a well initial contract sum with prime cost sums and provisional sums either entirely eliminated or kept to a minimum. The current study however seeks to fill the knowledge gap by undertaking a systematic study of the factors affecting the cash flow of the contractor in Ghana to propose an automated cash flow model based on the project parameters. A critical study of the Hohouabu's model indicates that it is rigorous and dependent on only one variable: duration, hence requiring further studies. The model in this paper is dependent on the most significant factors affecting the contractor's cash flow.

## RESEARCH METHOD

### Population

This paper is based on a mix methodological approach for data collection; quantitative and qualitative procedures. With the application of the quantitative data collection, a survey questionnaire was designed and administered to contractors, consultants and clients working on the district assembly common fund project. The sample size was determined through the Kish (1965) method from a population size of 26 consultants, 206 contractors and 38 district assemblies. In all, a total of one hundred and fifty two (152) questionnaires were sent out; 26 to consultants, 88 to D1K1 and D2K2 contractors and 38 to district assemblies in the Ashanti and Brong Ahafo regions of Ghana. The two regions apart from the Greater- Accra region represent the most populous regions in terms of the number of district assemblies, contractors and consultants in Ghana, hence their selection as a basis of data collection.

### Questionnaire design and data collection

The questionnaires listed 30 factors affecting the cash flow of contractors for respondents to rate. Respondents were requested to rate the above factors against a five point scale as 1- not important, 2- slightly important, 3- moderately important, 4- very important, 5- extremely important. All questionnaires were administered personally to the respondent during which advantage was taken to interview some top and middle level management staff. Respondents were given three weeks to fill the questionnaires after which they were personally collected for analysis. During the inter-phase between distribution and collection, respondents were called or e-mailed to remind them of the questionnaires; the above resulting in a high rate of response. In all one hundred and twenty three questionnaires were retrieved representing a response rate of 80.92%

### Data analysis

The quantitative data was analysed based on the five-point scale ratings provided by the respondents on separate categories. These ratings were combined to deduce the relative importance indices of the factors based on respondents, after which further analysis were made to compute the overall cash flow factors from the three responses based on the total sample size.



A significance testing was used to decide whether to accept or reject the null Hypothesis,  $H_0$ . Consistent with the above, an evaluation of the test statistics ( $X$ ) was computed and the probability (P-Value) of observing a value of the test statistics was also determined. The p-value was taken as the smallest value at which the significance level ( $\alpha$ ) could be present and still have small (lesser than 5% significance level). Secondly, based on the total sample size of contractors, consultants and district assemblies, a coefficient of variation (COV) was determined. This was used to determine the relative variability of the responses from the three groups to the factors that affect the cash flow of contractors. A relatively low coefficient of variation of 22.94 was deduced which indicates that there exists a relatively high agreement between the three respondents. Finally, in order to prove the authenticity of the above analysis, a test of hypothesis using the chi square distribution was determined.

At 95% level of significance, using the relationship:

$$X^2 = k (N-1) w$$

$$X^2 = 3(30-1) 0.731$$

$$X^2 = 63.55 > 45$$

Where  $N-1$  indicates the degree of freedom. At the chosen level of significance, the largest value for the acceptance of the null hypothesis is 45 which implying there is agreement between the three groups.

## DISCUSSION

Significant testing in Table 1.0 revealed 18 factors to be having significant effect on the contractor's cash flow in Ghana. These were then categorized under three generic considerations: monetary, partial-monetary and schedule related factors based on the characteristics of these factors.

Where A is interpreted as accepted and R interpreted as rejected.

Monetary factors which could be measured and directly quantified in monetary terms including advanced mobilization, amount, limit and treatment of retention, profit margins, discount on materials purchased, overhead expenses and value of preliminaries. A slight adjustment of any of the monetary factors would have a significant effect on the amount of money to be received any particular time.

Partial- monetary factors were grouped as generic factors that cannot be directly quantified in monetary terms but manipulation of such factors translated into changes of cash flow significantly affecting the contractor's cash inflow at any point in term. These factors include Pricing strategy (front end loading and back end loading), over measurement and under measurements and quality of measurements. Schedule related factors were inferred from their direct relation to time.

Most of the factors affecting cash flow are time bound and any manipulation of these schedule related factors has a bearing on when a contractor would receive some cash inflow. These factors include period of honouring certificate, time interval between cost commitments, time interval between two certificates and project time overruns.

Table 1: Significance testing of factors affecting cash flow of contractors

ITEM	FACTORS AFFECTING CONTRACTORS CASHFLOW	Mean	Standard Dev.	Coefficient of variation.	Weighted overall response	P-value	Interpretation of P-value
1	Contractual Specification for Minimum amount Valuation	3.59	0.58	16.08	0.72	0.09	A
2	Bank overdraft- (Availability of cash credit facility)	4.21	0.39	9.32	0.84	0.28	A
3	Advanced Payment	3.75	0.48	12.71	0.75	0.14	A
4	Timing interval between two certificates	4.09	0.57	13.92	0.82	0.17	A
5	Period of Honouring certificates by client	4.45	0.27	6.07	0.89	0.48	A
6	Rate of Retention	4.11	0.36	8.74	0.82	0.28	A
7	Limit of retention	3.63	0.43	11.92	0.73	0.13	A
8	Interest rates	2.86	0.70	24.52	0.57	-0.02	R
9	Degree of variation	2.88	0.60	20.79	0.58	-0.02	R
10	Withholding tax	3.48	0.92	26.48	0.69	0.05	A
11	Effective margins	4.63	0.21	4.61	0.93	0.69	A
12	Overheads	3.80	0.41	10.70	0.76	0.18	A
13	Pricing strategy (front end loading and back end loading, )	4.30	0.41	9.44	0.86	0.29	A
14	Over measurement and under measurements	4.46	0.27	6.07	0.89	0.49	A
15	Delay in paying creditors (material suppliers and plant hirers)	4.09	0.37	8.95	0.82	0.27	A
16	Quality of measurement accuracy in valuation	3.20	0.59	18.52	0.64	0.03	A
17	Company Cash flow	1.98	0.46	22.94	0.40	-0.20	R
18	Economic Instability/ Price Instability	3.20	0.58	18.23	0.64	0.03	A
19	Contract type (fixed, cost plus, etc)	2.14	0.50	23.32	0.43	-0.16	R
20	Poor Site management	2.32	0.46	19.76	0.46	-0.13	R
21	Experience of Contractor and level of mistakes during construction	1.99	0.43	21.43	0.40	-0.21	R
22	Poor Supervision	2.15	0.36	16.62	0.43	-0.21	R
23	Cost Overruns	2.73	0.66	24.13	0.55	-0.04	R
24	Number of projects being handled by the firm	2.54	0.50	19.57	0.51	-0.08	R
25	Sub Contractors retention held by main Contractor	2.47	0.92	37.28	0.50	-0.05	R
26	Discount on material purchased	3.80	0.41	10.70	0.75	0.18	A
27	Value of Preliminaries	4.06	0.39	9.68	0.81	0.24	A
28	Material On site	2.64	0.96	36.35	0.53	-0.03	R
29	Material in transit	1.20	0.10	8.61	0.24	-1.58	R
30	Time over-runs	3.12	0.70	22.55	0.62	0.02	A

## PROPOSED CASH FLOW MODEL

The models developed by Navon (1995) and Hohouabu (2005) were adopted for simulation to produce the automated cash flow model. Navon (1995) sought to solve the compatibility problem caused by different data structures of cost and the schedule of items. Consistent with the above, the implemented cash flow was developed using 15 factors identified during data analysis as the most important factors affecting the cash flow of Contractors in Ghana. Based on Hohouabu's result of basing cash flow on progress of work, progress was estimated using the straight line method with the assumption that work is approximately evenly distributed over the entire project duration. This is automated based on total number of months and estimated project delay. Baiden-Amissah (2000) field study and result on the delays on constructions in Ghana advised in the inclusion of a maximum of six months delay in the model.

The model estimates the cash inflow factors based on dates of valuation, contract duration and total number of certificates. The system architecture developed for the above model depicts the stages through which data is entered, stored, automated and converted to cash flow curves. The above system consists of four sections: the process visualisation, data to cash flow model, sequencing of data entry and representation of proposed cash flow model. The cash flow algorithm generator shown in figure 1 depicts the logical sequence of the proposed cash flow model. It refers to 13 stages of data simulation for the production of cash flow curves. The model runs through a series of phases based on integrated project parameters entered at the user inter-phase. These project parameters include total contract sum, overall mark-up, timing of valuation, period of honouring certificates, contract duration, advanced mobilization, amount, limit and treatment of retention. The straight line of calculating the value of work done per period depending on progress was adopted in the development of the automated cash flow. Where the value of work (V) done per period 'ψ' is calculated based on the total contract sum 'T' and progress 'S' in the equation:

$$V_{\psi} = S_{\psi} (T) \quad (1)$$

$$\text{Where } S_{\psi} = ((n/(N+\beta)) \times 100) \quad (2)$$

Where 'n' is the month under consideration, 'N' is the contract duration and 'β' is the total expected delay.

The automated model deduces the contractor's outgoings  $T_{\psi}$  at the end of period ψ from the Ashley and Teicholz (1977) formulae as:

$$T_{\psi} = (100 - m \%) \frac{C}{N} \times S_{\psi} + D \quad (3)$$

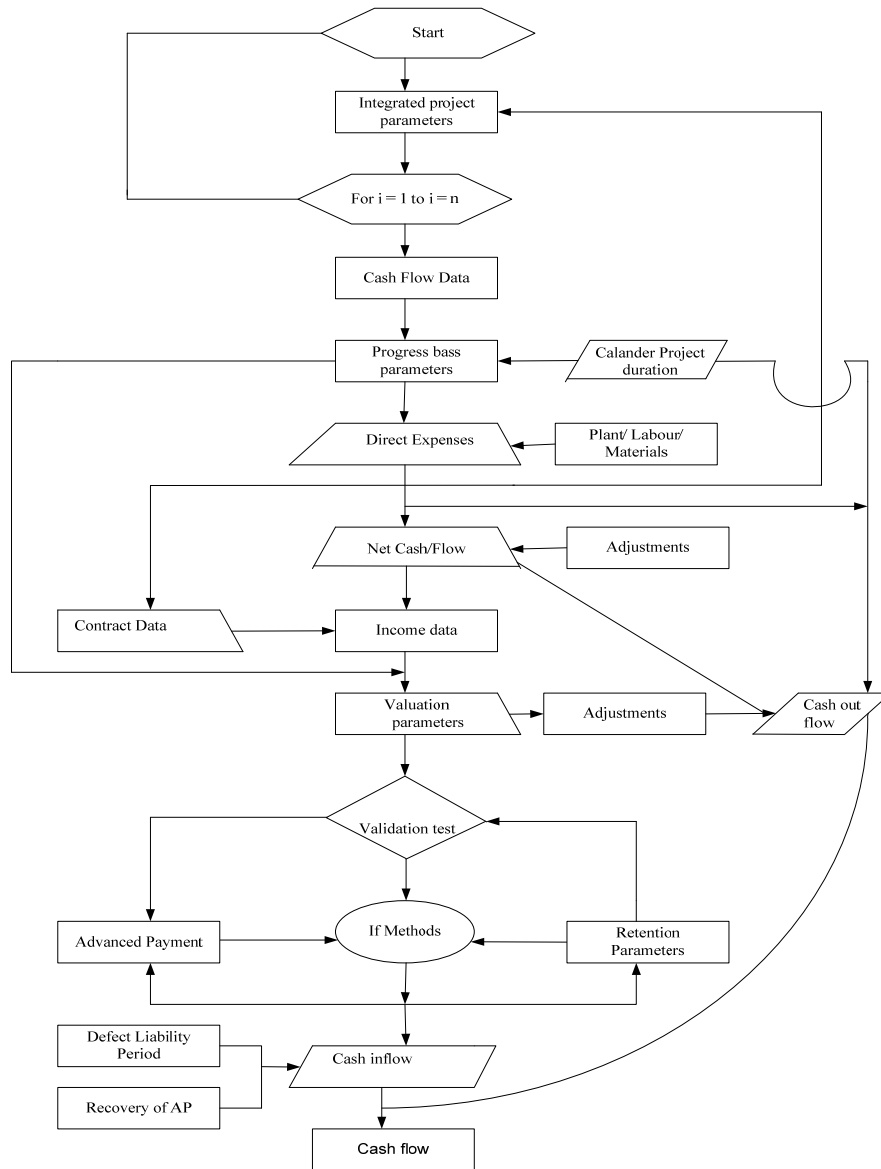


Fig 1 Cash flow Algorithm generator- implemented model.

Where Cost of works (C) = (((Contract Sum) – ((Profit% + Overheads %) x (Contract Sum)))

Where C is the Total contract sum, T is the estimated cash outflow, m% is the margins, D is estimated discount, N is the total duration, and  $S_{\psi}$  is the progress of works for month  $\psi$ . At any point in time, the treatment of retention is limited to the stage of construction until the limit of retention is reached. For any value of work done,  $V_{\psi}$ , in month  $\psi$ , the retention ( $R_{\psi}$ ) with percentage per period,  $\Phi$ , until the limit of retention is reached is given as:

$$R_{\psi} = \Phi \times V_{\psi} \quad (4)$$

The automated cash flow model deduces the net value of work done per period after retention and advance payment have been deducted as in the linear equation:

$$C_{\psi} = V_{\psi} - (R_{\psi} \% \times V_{\psi}) - AP_{\psi} + M_{\psi} \quad (5)$$

At the time of the release of the last certificate, the cash inflow then generates into:

$$C_{\psi} = V_{\psi} - (R_{\psi} \% \times V_{\psi}) + (0.5 \times (R_{\psi} \% \times V_{\psi})) - AP_{\psi} + M_{\psi} \quad (6)$$

Where  $C_{\psi}$  is the cash inflow for period  $\psi$ ,  $V_{\psi}$  is the value of work done for period  $\psi$

$R_\psi$  is the retention percentage for period  $\psi$ ,  $AP_\psi$  is the adjusted Advance mobilisation for period  $\psi$ ,  $M_\psi$  is discounts on material purchased only where discounts are enjoyed

At the user inter-phase of the model, one is expected to enter 15 project parameters including total contract sum, total value of preliminaries, total discount of materials and labour expected, profit and overheads percentage, contract duration, estimated delay, retention condition, treatment and limit, defect liability period, time interval between certificates, period of honouring certificates, time interval; between cost commitment and advanced mobilization. Based on the automation of the earlier discussed formulas, the cash flow model first deduces the progress per time frame as a basis for computing the value of work done. After simulating the above through retention and advanced payment and conditions, the cash inflow curves are generated. Concurrent to the simulation and generating of the cash inflow curves, the model would generate the cash out flow data dependent on inputs like the overheads expenses and the over all mark-up. Formulation of the cash inflow curves evolves from the resultant effect of all direct expenses including over heads and mark-up. With the completion of the processing stage, the above information is transferred to the final sheet for conversion to optical functions. This is deduced by the synergy and synthesis of the cash outflow function, cash inflow function and the net cash flow function.

### **Testing and validation of results**

Navon (1995) stated that studies on accurate cash flow models based on ideal values have produced conflicting results. Inferring from this, it is very difficult for any two models to give the same values, contrary to the above however, wide variations must not be observed. As a means of testing the model after development, numerous arbitrary set of hypothetical project parameters were inserted into the model. To ascertain the validity of the results obtained from the testing of the model, a validation test was undertaken using other existing models. Due to the Ghana case, the values used in the testing of the model were compared to results generated from the mathematical model developed by Hohoabu (2005). Comparing results obtained from these two models indicated marginal variations in the final Figures obtained in the outputs of the results. These variations were observed to be the result of differences obtained from the progress values translated into differences in final cash inflow, cash outflow and cumulative cash flow values obtained. In a hypothetical case whereas progress using this developed model was 10.00 in month one, the results obtained from the Hohoabu's approach was 11.29. Generally however, results obtained from the two models seem to converge.

The slight differences in the current model and the one developed by Hohoabu model stems from the fact that the above model makes provision for deducting items such as retention and advance mobilization which were not directly evolved on Hohouabu's model. When all the above parameters are stream lined and brought to the same strata, variations in the output results might be drastically minimised. The model developed is however restricted to a contract period of only eighteen (18) months, with estimated delay of six (6) monthly, and a maximum defect liability period of six (6) months. The total estimated possible duration the model could run is thirty (30) months. It is however known to have other features such as estimated delay, estimated discounts and value of preliminaries not available in other models.

## CONCLUSION

The cost accuracy of cash flow models is questionable; this is the reason for wide variability in cash flow profiles and the limited amount of resources it incorporates. Ghana specifically lacks an automated cash flow model suitable for our environment, the reason for developing this automated cash flow model. The failure of most construction businesses is due to the lack of finance to support their businesses in the relatively short term (Kaka, 1995).

This research reported in this paper discusses the development of an automated cash flow model with the district assembly common fund as a case study. The importance of cash flow forecasting is also discussed. The model developed was based on the fifteen most significant factors revealed during field survey and analysis which resulted in the categorisation of cash flow factors into three generic factors: monetary related factor, partial monetary related factors and schedule related factors. The model provides a user friendly means of generating cash flow which is characterised by rigorous arithmetic calculations, hence deterring most contractors from providing realistic cash flow budgets. The conclusion arrived is that most cash flow models are complex and the ambiguity which makes it non- applicable in third worlds like Ghana where economic parameters are unstable and there are serious flouting of terms of contract, extensive time and cost overruns, which has been incorporated in this model to make the cash flow projection more realistic.

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# CONSTRUCTION COST DATA MANAGEMENT BY QUANTITY SURVEYING FIRMS IN NIGERIA

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Information is the basis for making business decisions. How can the information produced be verified with ease and accuracy for the decision making by the top management? The study employed the review of related literature and well structured questionnaires were distributed through purposive sampling to Quantity Surveying firms with a view to determine usefulness of cost information and accuracy of sources of cost data and how cost information are being managed by the Quantity Surveying firms in Nigeria. Data generated were analyzed through SPSS. Findings indicated that cost information is highly significant in the preparation of Bills of Quantities, project cost control / management, cost planning, preparation of cost estimates. The study further revealed that cost data are not properly updated/ managed by the firms surveyed as a result of the effect of inflation on Construction prices, insufficient design information, lack of knowledge of the recent advances in computer technology such as use of software packages, computed aided design tools software, cost evaluation software and quantity calculation software. The study suggested that Quantity Surveying firms should fully adopt the software packages for cost information management. Also there should be an equivalent of BCIS (Building cost information services) in the Nigerian Construction industry with online access to information as in the United Kingdom.

Keywords: cost data, cost management, quantity surveying, cost control, cost analysis.

## INTRODUCTION

Quantity Surveyor is the cost expert whose prime task is to ensure that construction project is kept within the agreed budget and that the employer obtains value for his money. He is the centre of controlling construction cost as means of meeting the cost targets in order to keep construction project within the agreed budget (Ramus, 1981). Eke (2007) also asserted that a Quantity Surveyor is required to be the encyclopaedia of information on every aspect of building cost. The need to forecast and control construction activities necessitates efficient cost information management (Akintoye et al, 1992). Cost information during project execution helps in monitoring and meeting project time and cost targets.

Availability and adequacy of the essential cost information is highly important in the accuracy of cost estimate prepared by the Quantity Surveying firms and also in the control of construction activities. The problems of a Quantity Surveyor in a developing economy may not be easily appreciated (Akintoye et al, 1992). There has also been problem in the aspect of cost data management in Quantity Surveying firms

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in Nigeria the resultant effect has been on the Quantity Surveyors and even the construction researchers in the Construction industry.

The aim of the paper is to:

- Identify the usefulness of cost information in the Quantity Surveying firms.
- To determine the reliable sources of cost data in Nigeria.
- To suggest ways of improving cost information management in the Quantity Surveying firms in Nigeria.

## **BACKGROUND**

### **Quantity surveying firms in Nigeria**

According to Matipa et al, (2008), the role of a professional Quantity Surveyor is to provide information with regard to the initial and future costs so that sound financial factors – inter alia- are considered by the design team. Quantity Surveying firms perform a wide ranges of services ranging from the pre contract the post contract duties these includes management of costs of construction project from initial design plans to the building's completion, maintenance, renovation and demolition cost of buildings and facilities once they are in use, ensuring that projects meet legal and quality standard and that clients have good value for money.(Morrison 1984). Cost information is the basic requirement in the realization of the above listed duties. According to Ashworth (1998). Cost is one of the three pillars supporting project success. Construction cost control system has been a myriad of studies despite its relevance in terms of both improving the cost estimate and integrating schedule; it had hardly contributed to the integration of cost management and production control system.

### **Usefulness of cost data**

Preparing cost estimates normally requires the use of historical data on construction costs. Historical cost data will be useful for cost estimation only if they are collected and organized in a way that is compatible with future applications. Organizations which are engaged in cost estimation continually should keep a file for their own use (Hendrickson ,2008).The information must be updated with respect to changes that will inevitably occur. The format of cost data, such as unit costs for various items, should be organized according to the current standard of usage in the organization. Quantity Surveying firms need cost information for the following purpose:

- Forecasting cost of future projects
- Comparison of cost of different projects
- Negotiating of unit rates for Contractors
- Monitoring and controlling of construction cost
- Design cost planning

Historical cost data must be used cautiously. Changes in relative prices may have substantial impacts on construction costs.

### **Sources of cost data in Nigeria**

In Construction industry and Quantity Surveying circles, cost is generally referred to as the resultant of labour materials, plants and management deployed for a specific

activity and is charged according to the accounting system of an organization.(Ashworth,1998). The prediction of construction cost and price remain a central part of the provision of Quantity Surveying services. Construction cost management has even become more complicated with the introduction of new procurement methods, technologies resources and various professionals involved in a project (Perera and Imriyas, 2004). Together with procurement and contractual advice, provision and understanding of cost / price information remains crucial as a management support function within the overall management of construction projects. A RICS working party on cost information and data services in 1990 concluded that more research was required to refine the cost /price relationship in construction. With cost control a restricted form of cost analysis usually by elements, it is required in the first place to set targets, and there after a wider field of information is needed to check the cost of detailed aspects shown on working drawings against their target. Besides the fact that action cost control system has not improved much since the seventies, cost management and production control are treated independently as separate systems. From a management point of view, the effect to develop implement and operate system is only justifiable when the cost information provides effective support for decision making. Much analyzed data is obtained their targets priced bills and many need considerable adjustment prior to its use for cost planning. For cost planning to be effective, banks of cost or price data is needed because the average QS firms cannot possess sufficient cost information to provide an adequate base for cost plans covering a wide range of building types. It was for this reason that the building cost information service (BCIS) of the RICS was established in the United kingdom. One of its main functions is to publish and calculate cost analysis and other cost information to subscribing members. Construction cost data are also published in various forms by a number of organizations in the developed countries. These publications are useful as references for comparison. Basically, the following types of information are available:

Catalogs of vendors' data on important features and specifications relating to their products for which cost quotations are either published or can be obtained. A major source of vendors' information for building products is *Sweets' Catalog* published by McGraw-Hill Information Systems Company.

Periodicals containing construction cost data and indices. One source of such information is *ENR*, the McGraw-Hill Construction Weekly, which contains extensive cost data including quarterly cost reports. *Cost Engineering*, a journal of the American Society of Cost Engineers, also publishes useful cost data periodically.

Commercial cost reference manuals for estimating guides. An example is the *Building Construction Cost Data* published annually by R.S. Means Company, Inc., which contains unit prices on building construction items. *Dodge Manual for Building Construction*, published by McGraw-Hill, provides similar information.

Digests of actual project costs. The *Dodge Digest of Building Costs and Specifications* provides descriptions of design features and costs of actual projects by building type. Once a week, *ENR* publishes the bid prices of a project chosen from all types of construction projects.

Cost information for the building project may be organized or collected from a variety of sources (Ashworth 1980). However factors that influence the specific mode of collection of such cost information include the following:

Time available for collection.

Nature of the project for which information is required.

Availability and reliability of the sources of cost estimates

Expected frequency of the use of the specific cost information.

Availability of sufficient design information considering these factors, QS firms may generate its cost information in house or make use of other sources produce by outside organization which will be modified before being used.

The priced Bill of Quantities and Work schedules are the major sources of Cost information but the information in them must be used with great care (Robertson, 1973). Comparison of rates between two BOQ for the same projects will show a considerable variation for many of the items. Priced BOQ is considered the cheapest, fastest and most comprehensive way of gathering cost information but the data collected cannot be used directly until it is modified and adjusted where necessary before it can be applied to other projects.

From past literatures, Jupp (1984) stated that priced BOQ is the most accurate and reliable price of cost information in UK and this contradicts opinion that bill rates extracted from priced BOQ are less reliable than published data because vagaries of tendering which include errors incorporated through the lack of accurate cost data or through human error. According to Robertson (1973) the price information from the source should be treated with care due to variability in contractors' pricing.

Another source of cost information is the builder's price book. This is a traditional source of cost information .It provides useful information on current measured rates together with other data such as all-in-rates and constants cost of labour and materials which forms a useful guide but needs adjusting to local condition .Market survey is also another source whereby the Quantity Surveyor firms have interview with the local and national labour union plant hiring and purchasing firms, builders merchants subcontractors and suppliers of the building components in order to have a feeling of current market condition on plant, labour and material.

Technical press is another source of cost information .Data are gotten from some technical magazines, journals in the construction fields and some newspaper in Nigeria do published. Construction cost information such as basic price of materials, skilled and unskilled, labour rates, and elemental cost analysis with the rapid increase in the level of resources costs and measured rates over a short time span. The technical press has in many instances replaced priced books for quick reference materials. An example of such journals are Quantity surveying journals by the NIQS, Building trade journals, Guardian Newspaper, Punch newspaper etc.

## THE SURVEY

A comprehensive literature review relating to construction cost information management was undertaken and analyzed. Sources of cost information were also identified. Data were collected through structured questionnaire from Quantity surveying firms in Lagos and personal interviews with researchers making use of cost information data. 55 questionnaires were sent out within Lagos metropolis to different Quantity surveying firms but 43 were completed and returned as shown in Tables 1 and 2 .

Table 1 Questionnaires sent out

	Frequency	Percentage (%)
Questionnaire sent out	55	100

Questionnaire returned	43	78
Questionnaire unreturned	12	22

The experience of the Quantity surveying firms surveyed and their consultancy in Quantity surveying practice through their year of establishment 78% questionnaires were filled and returned which is adequate to elicit information for this study. 60% of the firms surveyed were established between 11-20 years ago which 28% were established 21 years and above years ago.

Table 2 Year of establishment of firm

Year	Frequency	Percentage (%)
6-10 years	5	12
11-20 years	26	60
Above 21 years	12	28

Table 3 shows that most of the respondents have between 11-15 years of experience followed by respondents between 16-20 years. This infers that the respondents have adequate experience in the profession.

Table 3 Years of experience of respondents firms

Year	Frequency	Percentage (%)
Below 5 years	6	14
6-10 years	3	7
11-15 years	21	49
16-20 years	9	21
Above 20 years	4	9

### Usefulness of cost information in quantity surveying services

Table 4 Significance of the use of cost information for quantity surveying services

	Mean	Rank
Forecasting future construction cost	4.6905	1
Preparation of preliminary estimates	3.8140	2
Preparing Bill of Quantities for new projects	3.7624	3
Negotiating of unit rates for contractors	3.7294	4
Monitoring and controlling construction costs	3.6279	5
Preparation of project cost limit	3.6071	6
Cost comparison of different construction types	3.5581	7
Preparation of elemental and comparative cost plan	3.5116	8
Design cost planning	3.4651	9

Quantity Surveyors need a ready access to Cost information for the following purposes such as forecasting cost for future projects, Comparing cost of alternative building options, Balancing of cost in getting budget for the cost control of building, Preparing preliminary estimates for proposed schemes, cost planning during design process, Preliminary cost advice before drawings are prepared and for preparation of

final account for projects cost. The degree of significance of usefulness of cost information for the following purposes was surveyed. Table 4 shows that forecasting future construction cost has high prominent use of cost information while preparation of preliminary estimate ranked second since Preliminary estimates provides basis budgeting and cost control of project. Design cost planning reflects the least use of cost information. Cost information is highly essential to the Quantity Surveying profession so it cannot be underestimated.

### **Accuracy and reliability of the available sources of cost information**

A Quantity surveying firm may generate its cost information in house or make use of other sources of cost information produced by outside organizations which are modified before they can be used. Table 5 shows the survey of the accuracy and reliability of the aforementioned sources as follows.

Table 5 Accuracy and reliability of the sources of information

	Mean	Rank
Priced Bills of Quantities	3.6977	1
Market survey	3.3128	2
Cost analysis prepared by individual Quantity surveying firms	3.3023	3
Technical press	3.1860	4
Builders priced books	2.9070	5

It is indicated from Table 5 that among the sources of cost information, the priced bill of quantities from successful tender claimed to be the most reliable source because it is the cheapest and the fastest. It can easily be gotten since the Quantity surveyor would usually prefer to use data of projects of which he knows the background. He is aware of all the obstacles associated with such projects, its location, the market condition, complexity and magnitude etc of such projects which influence its price. This contradicts Ashworth (1980) claim that such cost information extracted from such source are less reliable but it is advised that before such information can be used, it should be modified. Market survey (comprising of quotations from specialist subcontractors, labour unions, builders merchants and suppliers of building component) ranked second but is not widely adopted by most Quantity surveying firms. This is because of the required to carry out the market survey and translating the information gotten to contracts resources input costs. Builder's price book ranked least on the list because in period of high inflation, it has suffered a big set back of having to prepare its information well in advance of the year of publication.

### **Management of cost data in Quantity surveying firms**

In order to examine the management system of historical cost data in QS firms, respondents were asked to rank the constraints that serve as impediments to realistic updating / management of cost data. Table 6 shows how the Qs firms ranked the identified constraints.

Table 6: Constraints in updating / management of cost data in QS firms

	Frequency	Percentage (%)
Inflation effect on construction prices	40	93
Insufficient design information	35	81

Lack of knowledge of the use of computer softwares	31	31
Poor office organization in storing of data	31	72
Pricing problem of BOQ	20	47
Professional inexperience	14	33

The inflation rate in Nigeria claimed to be the greatest constraint, insufficient design information/relevant data ranked next while professional inexperience ranked last.

### **Use of Integrated information management system**

With the rapid development of information technology, the traditional business is deeply affected by the e-commerce and the management strategies of traditional industries are undergoing a fierce evolutionary change. The features includes

- Fast speed-real time service, quick response and update
- Large quantity
- Low failure rate

Table 7: Use of information technology in Nigerian quantity surveying firms

	Mean	Rank
Use of word processing and spreadsheet for office and contract administration	3.7907	1
Use of computer as a means to develop and store adequate database	3.4651	2
Use of cost evaluation software	3.0000	3
Use of quantity calculation software	2.9535	4
Use of quota management software	2.6047	5

In the survey carried out Shein and Jacky (2007) it was concluded that although IT had been widely used in QS organizations in Hong Kong, it is mainly used to support various individual tasks of the QS services at a basic level, rather than to streamline the production of QS services as a whole through automation. IT plays an important role in the QS profession but most QS firms in Nigeria has not taken advantage of IT to improve their competitive edge in the market. According to Perera and Imriyas (2004), many QS firms agree that Computer integrated information management system is the best solution to improve the efficiency and competitiveness in today's dynamic industry. The respondents were asked to rate the use of Information technology in their various firms. Table 7 shows their responses.

It is indicated that most organization have the general, computer / word processing and spreadsheet software and most of their employees are quite familiar with such software. However most of them are reluctant to use the advanced software because of the high cost, support services to such software and the specific training requirement. This is similar to the report of Hegazy and Ersahin (2001) on their survey on subcontractors' information system. Shein and Jacky (2007) stated also that very few QS organizations in Hong Kong have a comprehensive policy in promoting the use of IT within the organizations in order to assist the industry in achieving the aforementioned advantages.

## CONCLUSIONS AND RECOMMENDATIONS

The study has examined how cost data is being managed by the Quantity Surveying firms in Nigeria stressing the usefulness of Cost data in the industry. The reliable sources of cost data are the Priced Bill of Quantities, Market survey and Cost analysis prepared by individual Quantity Surveying firms. QS firms in Nigeria should endeavour to make use of comprehensive and accurate cost data source to help the Client in his decision making. The use of IT is expanding rapidly, it is recommended that the QS profession must recognize the importance of IT and take appropriate actions to meet the challenges of ever-changing and competitive market place. There should be a Nigerian equivalent of BCIS, sharing cost information among members with online access as this will improve accuracy of Quantity Surveying profession in Nigeria with resultant improvement in the public image.

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# CONSTRUCTION PROJECT DELIVERY IN GHANA: THE PERFORMANCE OF THE TRADITIONAL PROCUREMENT METHOD

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The traditional method of procurement (DBB) is mostly used in Ghana and widely criticized by stakeholders in the construction industry for being ineffective. Most stakeholders in the construction industry of Ghana continue to use this method as more than 90% of construction projects are executed via this method. Yet complain about the method's inability to deliver projects within the scheduled project duration, budgeted project cost and acceptable project quality continuous unceasingly. This research used historical records of completed DBB projects to assess the performance of the procurement method in terms of its ability to deliver projects within cost, time and with acceptable quality. The study was carried out through a questionnaire survey and secondary data on 62 completed building projects. Another questionnaire was designed to solicit experts view on what project in Ghana could be described as successful. The result pointed to the fact that a successful project should not record cost and time overruns above 10% of the projects' cost of works and should be of acceptable quality. Analysis of variance was used to ascertain whether the projects studied were successful based on the established performance criteria. The data analyses revealed that most projects in Ghana carried out through the traditional procurement method records high cost and time overruns and are of averagely good quality. The data is limited to a small sample of 62 building projects. This limitation arises because of the data collection approach, which is direct contact with historical project documents. The findings from this study can serve as a reference tool for stakeholders and researchers in decision making at the early stages of building projects in Ghana. The results from this study are also intended to stimulate debate on the need to employ alternative procurement methods which have the capacity to improve on project performance in Ghana.

Keywords: cost, performance, quality, time, traditional procurement method.

## INTRODUCTION

Construction projects are normally initiated by the needs of the client. In order to meet the client's requirements in terms of cost, time and quality, various procurement methods are employed to increase the chances of success of the project. The traditional procurement method (DBB) has been commonly used in delivering construction projects for many years. It has become the predominate method for projects delivery in Ghana (Obeng-Ayirebi, 2002) and still popular in USA (Rowlinson, 1997; Friedlander, 1998). However, DBB have been criticized for being lousy in its project delivery since it is characterized by late completion, cost overrun and poor quality (Nikko-Annan, 2006). Despite these damning discoveries by some

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researcher, the usage of the method is gaining more grounds and there is no indication of a paradigm shift to the usage of newer and effective procurement methods in Ghana. Perhaps these reports have not shown enough evidence to necessitate a serious debate as to the need to look for alternative procurement method in the country. It is widely known that the Emmerson report of 1962 and Banwel report of 1964 criticized the traditional contracting procedure and served as a catalyst for the shift towards integrated procurement routes in the United Kingdom.

The purpose of this research was basically to evaluate and critically assess the performance of DBB in the Ghanaian construction industry so as to afford stakeholders the opportunity to reflect on whether or not to join the chorus clamoring for alternative procurement methods. Though some research has been done in this area, none have measured the performance of the traditional procurement method via the historical records of the completed works. Osei-Tutu E. (1999), attempted to evaluate the performance of various forms of procurement methods in use in the country but this exercise was based on public and experts opinion. It is against this background that the researchers see this exercise as being essential.

The objectives of this study are therefore:

1. to establish a benchmark for the measurement of successful projects in Ghana;
2. to evaluate the performance of DBB projects in Ghana;
3. to compare the performance of DBB projects with the established benchmark.

## **PROCUREMENT PERFORMANCE ASSESSMENT CRITERIA**

Project performance has been considered to be synonymous to project success and this is also linked to project objectives (Chan and Chan, 2004). Chan and Chan (2004) developed key performance indicators for measuring project success. This includes cost, time, quality and functionality. Traditionally, most clients have required projects to be completed on time, within budget and to the highest quality though in recent years environmental and legislative requirements have attained prominence. Time, cost and quality are the basic criteria for project success/performance, and they are identified and discussed in almost every research work on project success, including Lam et. al., (2007), Chan and Chan, (2004), Hatush and Skitmore (1997) and Belassi and Tukel (1996). A project is successful if it is completed within budget, on schedule, conforms to user's expectations, meets specifications and attains quality workmanship (Songer and Molenaar, 1997).

The authors endeavoured to appraise project success by adopting cost, time and quality as the yardstick for measurement of project performance in this study. This, they believe would allow all stakeholders to appreciate the work since these basic project objectives are well known by project participants (Phua and Rowlinson, 2004).

### **Projects cost performance**

Project Cost Performance is defined as the degree to which the general conditions promote the completion of a project within the estimated budget (Bubashait and Almohawis, 1994). Cost is not only confined to the tender sum, it is the overall cost that a project incurs from inception to completion, which includes any costs that arises from variations and modifications during construction period (Chan and Chan, 2004).

According to Yeong's (1994) cited in Chan and Chan (2004), cost performance is measured in terms of percentage of cost overrun on a project. This is done by considering two variables; overruns due to variations and fluctuations.

Percentage net variation over final cost (per cent NETVAR) is the ratio of net variations to final contract sum expressed in percentage terms. This gives an indication of cost overrun or underrun due to variations:

$$\text{Per cent NETVAR} = \frac{\text{Net value of variations} \times 100 \text{ per cent}}{\text{Final contract sum}}$$

Where, Net value of variations = Final contract sum – Base

Base = Original contract sum + Final rise and fall – Contingency allowance

$$\text{Per cent NETFLUC} = \frac{\text{Net value of fluctuations} \times 100 \text{ per cent}}{\text{Final contract sum}}$$

Where, Net value of fluctuations = Final contract sum – Base

### **Project time performance**

Project construction time refers to the duration for completing the project. It is scheduled to enable the building to be used by a date determined by the client's future plans (Hatush and Skitmore, 1997). Time is an important factor in any project, especially in construction projects since project cost is tied to project time (Long and Lee, 2009).

According to Chan and Chan( 2004), time overrun is assessed by the percentage of increase or decrease in the estimated project duration in days/weeks, discounting the effect of extension of time (E.O.T.) granted by the client.

$$\text{Time overrun} = \frac{\text{Revised contract period} - \text{Original Contract Period}}{\text{Revised Contract period} \times 100 \%}$$

Where, Revised contract period = Original contract period + EOT

### **Project quality performance**

Parfit and Sanvido, (1993) defines project quality as the totality of the features required to satisfy a given need. Clients' long-term interests lie in the high quality of their projects. The work performed must conform to the specifications established for the project. Low cost and speedy construction should not be achieved at the expense of the quality of the project. In fact, poor quality of performance results in increased rework, which has significant cost and schedule implications (Hong and David, 2002). However, construction quality may sometimes be taken for granted and insufficient attention may be paid to it (Rad and Khosrowshahi, 1998). Assessment of project quality has always been subjective (Chan and Chan, 2004).

## **RESEARCH METHOD**

### **Data Collection**

Two methods of data collection were used to achieve the study objectives. In order to address the first objective set for this study, data was collected from the files of 62 construction projects completed between 2000 and 2007. The data was obtained from the office of quantity surveying firms, D1/K1 construction firms and clients organizations in three regions of Ghana (Greater Accra, Ashanti and Brong Ahafo). Projects considered for this study were limited to those with contract sum not less than Hundred Thousand Ghana cedis (GH¢ 100,000.00) which is equivalent to \$71,000.00 US dollars. Information obtained in respect of each project included: project type

(residential, industrial, hostel, classroom), procurement method, initial contract sum, final contract sum, contingency, net fluctuation, variations, commencement date, completion date, extension of time granted and official hold-up period. The approach used by Chan and Chan (2004) was adopted to determine the cost and time overruns on each project.

Quality was however subjectively measured by ranking stakeholder's satisfaction with quality of projects with respect to workmanship, materials used and functionality of the projects. Respondents ranked the level of quality/satisfaction on a 5-point likert scale from 1 "highly unacceptable" to 5 "highly acceptable quality".

In order to address the second objective of this study, a different set of questionnaire were distributed to quantity surveyors at the 5th Surveyors week, Commonwealth Association of Surveyors and Land Economy (CASLE ) and International Federation of Surveyors (FIG) conference held in Accra, Ghana from the 26<sup>th</sup> – 28<sup>th</sup> February, 2010. Information obtained from the respondents who were purely experts in project management/contract administration from construction firms, quantity surveying firms and client organizations across the country is presented in Table 1. This data was mainly analysed using descriptive statistics.

To achieve the third objective set out for the study, two-sample t-test was performed on the data with the aid of Statistical Package for Social Science (SPSS 17) to ascertain whether the projects were successful using the established success criteria as a yardstick.

### **Data analysis, results and discussion**

The questionnaire survey on historical records of projects yielded a response rate of 34%. The respondents comprised 16 clients, 22 contractors and 24 consultants. With respect to the questionnaire on the establishment of projects success criteria, response rate of 75% was recorded. The high response rate here is attributed to the fact that all the professionals had congregated at one place for a conference. Altogether, the data had come from quantity surveyors from academia and industry and for that matter the highest echelon of quantity surveying professionals in Ghana and their responses can be confidently relied upon.

### **Determination of success criteria**

The results from the survey on project success criteria collated are presented in Table 1. In this Table, frequencies and percentages are derived and presented in order to summarize the data obtained from the survey. Despite the small sample size of respondents, it was deemed useful and adequate due to the high caliber of respondents. The results from the survey showed 58.82% and 55.88% of respondents agreeing that a success project in Ghana is the project that records a maximum of 10% cost and time overruns respectively. This result in a way deviates from Project Management Institutes (PMI, PMBoK) success criteria which suggest that a successful project should record zero cost and time overruns. None of the respondents from the survey agreed with the proponents of the theory of zero time and cost overrun. In Ghana, the cost of building materials has always been on the rise which obviously means that at every valuation, contractors are paid fluctuations to compensate for any loss due to price changes.

Eyiah and Cook (2003), reported among other things that, the poor time performance of construction projects in Ghana is attributed to bureaucracy, as processing of payment certificates involves over thirty steps from invoice to receipt of the payment

cheque. Any undue delay in honouring payment certificate has negative implications on the overall project duration. These and many other factors may have informed the experts to give allowance of 10% of contract duration in setting a benchmark for a successful project with regard to time.

The measurement of success was believed to be subjective. Most respondents tied project quality to the satisfaction of stakeholders with the completed work.

Table 1: Result on project success criteria

PROJECTS SUCCESS CRITERIA (OVERRUNS %)	COST		TIME	
	Frequency	%	Frequency	%
0	0	0.00%	1	2.94%
1 – 10	20	58.82%	19	55.88%
11 – 20	8	23.53%	6	17.65%
21 – 30	2	5.88%	3	8.82%
31- 40	0	0.00%	1	2.94%
41- 50	2	5.88%	2	5.88%
> 50	2	5.88%	2	5.88%
Total	34	100.00%	34	100.00%

### Performance of DBB projects

The survey results were transformed to percentage deviation from the original cost or time. This is summarized and presented in Tables 2, 3 and 5. The evaluation of the projects in terms of cost revealed that, averagely projects in Ghana attracts cost overrun of 25% of the initial construction cost. The review of 62 works contracts which represent a significant part of public expenditure indicates that some 59.4% incurred cost-overruns above 20% of the initial amount. It is also worth noting that all the 62 projects reviewed representing 100% recorded cost overruns of some sort. This cost overrun arises out of fluctuations due to the ever increasing cost of building materials in Ghana and variations which is attributed to arbitrary revision of designs.

Construction time relates to the duration for completing the project. The result on the projects time performance is also presented in Tables 3 and 5. A simple analysis of the data from respondents showed that DBB projects in Ghana are always likely to be completed after the scheduled completion date. The average time overrun recorded from the analysis of the 62 projects reviewed is as high as 83% of the initial contract duration. Additionally, 32.2% of the projects reviewed attracted time overruns above 100% of contract duration. This therefore means that clients in Ghana are been denied of the usage of their facility on continuous basis which leads to loss of revenue that would have been accrued from the usage of such facility.

Many reports have described the performance of construction projects in Ghana as generally poor. Crown Agents (1998) found out that contracts for both works and consultancy services take very lengthy periods to reach financial closure and are subject to unnecessary delays. These delays have been attributed to extensive post-award negotiations, delays in the preparation of technical specifications and drawings, delays in evaluation, an extensive system of controls, reviews and approvals, and land ownership disputes (Westring 1997). World Bank 1996 and recently 2003 reports

revealed that projects implementation has been characterised by extensive cost and time overruns and poor quality.

Table 2: Summary of projects cost performance

Performance Range	Cost overrun due to fluctuations		Cost overrun/underrun due to Variations		Aggregate cost overrun /underrun on the project	
	No.	(%)	No.	(%)	No.	(%)
< 1%	17	27.4%	2	3.2%	0	0%
1% - 10%	25	40.3%	22	35.4%	11	17.7%
11% - 20%	17	27.4%	24	38.7%	14	22.5%
21% - 30%	3	4.8%	4	6.4%	20	32.2%
31% - 40%	0	0%	5	8%	5	8%
41% - 50%	0	0%	4	6.4%	7	11.2%
> 50%	0	0%	1	1.6%	5	8%
Total	62	100%	62	100%	62	100%

Table 3: Summary of projects time performance

Performance Range	Time Overrun/underrun	
	No.	(%)
< 1%	6	10
1% - 10%	5	8
11% - 20%	5	8
21% - 30%	4	6
31% - 40%	2	3
41% - 50%	8	13
51% - 100%	12	19
>100%	20	33
Total	62	100%

Table 4: Results on satisfaction with the general quality of project

Stakeholders' satisfaction	Quality of material used		Quality of workmanship		Functionality of the completed project	
	Frequency	%	Frequency	%	Frequency	%
Highly Unacceptable						
Unacceptable						
Slightly Acceptable	7	11.3				
Acceptable	40	64.5	44	71.0	39	62.9
Highly Acceptable	15	24.2	18	29.0	23	37.1
Total	62	100.0	62	100.0	62	100.0

Quality was qualitatively assessed and provided an indication on how well the stakeholders were satisfied with the completed project. The result in Table 4 indicates that in general the participants were fairly satisfied with the quality (materials used, workmanship and functionality of the completed project) performance of the projects. A total of 64.5% were satisfied with the quality of materials used whilst 24.2% were highly satisfied with same. On the quality of workmanship, 71% and 29% were satisfied and highly satisfied with the quality of workmanship respectively. 62.9% were satisfied with the functionality of the project whilst 37.1% were highly satisfied with the functionality of the projects.

Table 5 : Cost and time performance of 62 completed DBB projects

PROJECT NO.	COMPUTED		PROJECT NO.	COMPUTED	
	COST OVERRUNS	TIME OVERRUNS		COST OVERRUNS	TIME OVERRUNS
	%	%		%	%
1	3.6	0.00	32	4.76	50.00
2	11.16	200.00	33	48.05	104.17
3	26.49	174.07	34	18.48	-5.00
4	55.36	82.47	35	20.70	104.17
5	8.45	16.67	36	6.33	0.00
6	17.23	89.58	37	13.04	64.18
7	50.35	50.00	38	31.00	28.00
8	25.85	33.33	39	13.04	0.00
9	22.49	116.67	40	4.06	12.00
10	25.04	49.12	41	1.77	66.67
11	64.58	150.00	42	8.07	5.26
12	26.96	33.33	43	14.16	6.00
13	31.93	109.09	44	41.18	23.00
14	24.39	7.67	45	53.42	300.00
15	31.79	50.00	46	20.26	83.33
16	15.12	395.00	47	43.56	230.00
17	25.75	22.22	48	21.37	8.33
18	2.80	29.41	49	9	10.00
19	49.10	328.57	50	31.92	0
20	19.00	212.87	51	16.44	0
21	24.30	20.00	52	27.47	20.000
22	20.61	50.00	53	21.26	40
23	27.84	150.00	54	41.30	75.00
24	1.40	100.00	55	70.77	80.00
25	20.62	125.00	56	19.19	13.00
26	31.02	104.55	57	19.9	75
27	21.49	83.33	58	23.98	266.67
28	18.52	75.00	59	20.19	116.67
29	21.24	181.00	60	27.27	50
30	2.40	50.00	61	49.88	70.83
31	43.47	116.67	62	17.10	50.10
AVERAGE PERFORMANCE				25	83

The data from 62 projects were further analysed more closely to investigate the trends uncovered by the preliminary analysis in Table 5. Sample t-test was used to compare the mean estimate of each project overrun/underrun against the success/performance benchmark set. The aim was to investigate whether the projects performed well with respect to cost, time and quality using the success or performance criteria as a measuring rod. The results in Tables 6, 7 and 8 show that there are significant differences between the performance of the projects reviewed and the established cost and time performance limits set as the t-test produced  $p=0.00$  for both cost and time. The analysis revealed the following differences: (i) There is a significant difference between the cost performance of the projects reviewed and the project cost performance indicator established; (ii) the time performance of projects reviewed significantly differs from the project time performance indicator established.

The findings from this research points to the fact that there have not been any improvement in project delivery in Ghana over the years though a lot of work has gone into the study of factors that affect project performance.

Table 6: Results of analysis of cost and time overruns - paired samples statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Cost overrun	24.67	62	15.689	1.992
	Success criteria	10.00	62	0.000	0.000
Pair 2	Time overrun	83.11	62	85.677	10.881
	Success criteria	10.00	62	0.000	0.000

Table 7: Results of cost and time overruns - paired samples test

		Paired Differences		
		Mean	Std. Deviation	Std. Error Mean
Pair 1	Cost Overrun – Success Criteria	14.667	15.689	1.992
Pair 2	Time Overrun – Success Criteria	73.113	85.677	10.881

Table 8: Results of analysis of cost and time overruns - paired samples test

	Paired Differences					
	95% Confidence interval of the Difference					
	Lower	Upper	T	df	Correlation	Sig. (2-tailed)
Pair 1 Cost Overrun – Success Criteria	10.682	18.651	7.361	62	0.00	0.00
Pair 2 Time Overrun – Success Criteria	51.355	94.871	6.719	62	0.00	0.00

## CONCLUSION

Performance measurement is a way of drawing stakeholder's attention to the failures or success of some aspects of the construction industry and ultimately leads to improved performance. The authors believe, this is the first rigorous assessment of the performance of any procurement method in Ghana. Based on the survey of 62 completed projects this paper provides substantial evidence that majority of DBB projects are unable to meet projects' budget and time. It is also clear from the analysis that respondents were satisfied with the materials used, workmanship and functionality of the projects and for that matter the quality of DBB projects. These findings could not be generalized due to the relatively limited nature of the population. A larger population would generalize the findings and may provide better insight into the actual performance of building projects in Ghana. It is recommended that stakeholders in the industry should be more pragmatic in trying to improve on the projects delivery of the traditional approach by taking practical steps to address factors contributing to the poor performance of projects in the country.



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# **COST ESCALATION OF MAJOR INFRASTRUCTURE PROJECTS: A CASE STUDY OF SOCCER CITY STADIUM IN JOHANNESBURG**

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Major projects have consistently presented immense challenges on costs and programmes. Previous studies suggest that lessons could be learned from such cost and programme challenges but questions arise as to the transferability of such lessons to future projects. Using a case study approach underpinned by an audit review of the iconic Soccer City Stadium for the 2010 World Cup finals, the paper examines the underlying causes of the seventy-six percent increase in cost and thirty-three percent increase in duration of the project, identifies the responsible parties and describes how the lessons learned from resolving or failing to resolve the challenges could be transferred to future infrastructure developments. The most critical issue is to quantify the risks facing the client, to the fullest extent, and to allocate the management of the key risks unambiguously prior to and during the construction phase.

Keywords: client, infrastructure project, project management, cost, South Africa.

## **INTRODUCTION**

Major projects have consistently presented immense challenges, particularly on cost overruns and delays. In their hugely explanatory article, Flyvbjerg, Garbuio and Lovallo (2009) disclose the result of a study of major projects in 20 countries, which showed that nine out of ten projects had significant cost overruns ranging up to 70% of initial estimate. Famous examples include the Sydney Opera House (1959 – 1973 and 2002), which was completed ten years later than scheduled and 1,400% higher than initially budgeted (AUS\$7 million – AUS\$102 million), a world record. The cost of the Channel Tunnel was double its forecast cost in inflation-adjusted dollar terms. In South Africa, the Gautrain project commenced at an initial estimate of R7 billion and is projected to be completed at R25.4 billion (US\$3.3 billion). An important finding from Flyvbjerg, Garbuio and Lovallo's (2009) study is the non-transferability of lessons learned from one mega project to another due to changing project participants and administrators.

Since achieving the nod in 2004 to host the 2010 FIFA Soccer World Cup, South Africa has invested about R30 billion (US\$4 billion) in upgrading and installing new infrastructure directly related to the soccer event. Five new stadiums have been built and another five given major upgrades to host the event. The construction costs for all of the stadium projects exceeded the initial budgets but to varying extent.

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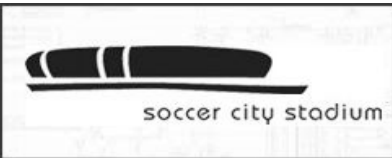
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The paper focuses on pertinent aspects of the delivery of the Soccer City Stadium project to identify the reasons for significant overruns on project objectives and contextualise important lessons for future major infrastructure developments.

The frame of analysis is *ex post facto* reflection on decisions and outcomes on the project. The author was appointed audit quantity surveyor on the project in May 2007 shortly after tender award. The duties include: participation in pertinent design meetings, weekly site progress reviews and site meetings, review of monthly interim valuations and payments to the contractor, assessment of, and opinion on, *ad hoc* exceptional items and generally anticipating and reporting on issues that pose risks on costs and progress.

## SOCCKER CITY STADIUM

Billed as the flagship of the 2010 World Cup stadiums (SAA, 2010), the landmark 90 000-seat Soccer City Stadium in Johannesburg was intended to be a major refurbishment of the old 80 000-seater FNB Stadium. However, the extent of the refurbishment includes full spectrum of new work including foundations, new structure, 70% enclosed roofing, seating and all-new finishes. To put this in perspective, the project required 1 200 piles, 80 000 m<sup>3</sup> of concrete, 10 000 tonnes of steel reinforcement, 14 000 precast elements, 38 000 m<sup>2</sup> of fibre cement cladding and 54 000 m<sup>2</sup> of roof fabric (see Fig. 1)



Key Quantities	
Seats:	90,000
Concrete Volume:	80,000 m <sup>3</sup>
Rebar:	10,000 tons
Formwork:	174,000 m <sup>2</sup>
Slabs:	65,000 m <sup>2</sup>
Piles:	1,200
Precast Elements:	14,000
Structural-Steel:	7,100 ton
Cladding:	38,000 m <sup>2</sup>
Excavation:	105,000m <sup>3</sup>
Earth Fill:	45,000 m <sup>3</sup>
Brickwork:	900,000 m <sup>2</sup>
Roof-Fabric:	54 000 m <sup>2</sup>

Fig. 1 Key Statistics for Soccer City Stadium

Source: <http://www.soccercity2010.co.za/vital.asp> (retrieved on 04 June 2010)

Construction cost of the Soccer City Stadium was revised from the initial contract sum of R1.916 billion to the latest sum of R3.378 billion excluding value added tax, an

increase of 76%. Not all aspects of the project foreseen and defined at the tender stage accounted for the entire revised amount; rather some new items were introduced belatedly into the project either to meet the FIFA standard specifications or to ensure full and sustainable functionality of the Stadium on completion.

The reasons for the cost overrun can be categorised, in no specific order, into: design, procurement, project management, construction management, client, project-specific and macro-economic factors.

### **Design**

Over 50% of items or elements of the project were not fully designed at the time of tender, resulting in provisional amounts being allocated for procurement of the elements through the use of specialised firms. This was an unequivocal factor in the later escalation of project costs. When designs were fully developed, all selected subcontract items escalated in cost from R1.17 billion to R1.74 billion, an increase of 49%. It appears the design team assumed that initial higher subcontract amounts would be off-set by savings in later elements. Value engineering exercises were done and possible future savings were suggested but suggested savings either did not materialise or were totally inadequate.

Furthermore, as the design developed, a number of items which were not included in the tender were defined and included in the project scope, such as embankment seating and fit-out of hospitality suites.

The lesson to be learned in this context is to persevere and complete the design development before embarking on a traditional-type procurement approach as was used in the project. Alternatively, the quantity surveyors' initial cost report should have advised the client of a cost range for the provisional design items to obviate the shock of subsequent sharp increases in cost.

### **Procurement**

The Soccer City project was procured on traditional procurement, based on the popular Joint Building Contracts Committee (JBCC) principal building agreement (JBCC, 2005). Given the extent of incomplete design at the time of tender, an alternative procurement approach should have been considered. A possible constraint was client capacity to manage an alternative procurement approach.

The procurement of professional services through a single-point appointment of a principal agent was a sound decision. However, inadequate safeguards were built into the expectation that the principal agent would properly manage the design consultants, particularly the integration of design inputs. The reward structure of percentage fee based on project value was also misaligned with the client's key objective of delivering the project within a defined budget limit (Turner, 2004).

For future infrastructure procurement, careful assessment of alternative procurements approaches for both contracting and consulting services must be made. Sufficient knowledge exists on alternative procurement approaches that align more appropriately with key client objectives and client contexts (Turner, 2004).

### **Principal agency and project management**

One critical role of project management is to quantify the project risk and advise the client of likely cost movements before these become reality (CIOB, 2010). This was done to some extent by mid-2008 when the budget was revised from R1.916 to

R2.584 billion due to escalated cost of the roof structure and fabric, foreign exchange movements and higher than normal escalation increases. The subsequent increase from R2.584 billion to R3.378 billion took most of the project participants by surprise, including the client and the auditors. While much of the additional costs may be factual, the lack of prior engagement of the client on the emergence of these is a shortcoming of project management. In particular, cost increases that are attributable to design changes made without prior client approvals or with implied client approvals reflect poorly on the performance of the principal agent. The expected process of reduction of uncertainty through time (Winch, 2010) was not achieved on this project and is a failure of principal agency and project management.

### **Construction management**

A significant portion of the cost increase is attributable to slippages of construction programme. The contract period was 27 months, with initial contractual completion date of 23 April 2009. As at November 2008, the main contractor was confident of completion by a revised date of 14 July 2009. By early January 2009, this revised completion date was no longer achievable. A revised programme was awaited from the contractor for weeks and, upon issue, indicated a revised completion date of end September 2009. The main contractor cited delays in installation of roof structure and components at the roof level, work which was done by selected subcontractors under the contractual control of the main contractor. With the delays, the main contractor has claimed compensable extension of time on the basis of increased scope of work and delayed design information. Admittedly, the programming of such a complex project is a significant challenge but the client has not benefited fully from the expected expertise and experience of the CIDB Grade 9 main contractor in resolving such complexity. The principal agent's oversight of the programme has been far from ideal, perhaps compromised by the principal agent's additional role as the civil engineering design consultant.

An important lesson is that, for reduction of uncertainty in the delivery of complex infrastructure projects to be achieved, the management of the construction programme should not be left to the expertise of one party alone, with the other party relying on contract provisions alone to enforce compliance or penalty. The principal agent should also not have a subsidiary consulting role on the project, as this can compromise the management of the delivery process.

### **Client**

The most effective risk mitigation strategy on construction projects is for identified risks to be allocated to the party that is best able to mitigate it (see explained in the Project Risk Management section of the PMBOK published by PMI, 2004: 237-268). Hence, the risk of site productivity is borne by the main contractor while the risk of future cash flows is borne by the client. Subject to the completeness of design information, the risk of price fluctuation is allocated through the form of contract to either the client or the contractor or to both; similarly the risk of currency exchange rate if materials are to be imported from abroad. In this case, substantial exposure to foreign exchange fluctuation was known at the time of initial contract as the main contractor tendered in joint venture with an overseas partner and required guaranteed overseas remittances of a portion of project earnings. Further, subsequent to the initial contract being signed, a foreign firm was appointed to execute the structural steel work and demanded a linkage of its payment to a foreign exchange base rate.

The client was ambivalent in responding to the first foreign exchange risk exposure and, having been obliged to accept the risk belatedly, has incurred significant unbudgeted expenditure of R65 million.

On the second risk exposure, two options were open to the client and either option needed to have been factored into the project budget. One option was to take forward cover on the foreign exchange exposure and thereby transfer the risk of fluctuation to the financial institution that would provide the cover. There could be a view that this was the appropriate decision but there is no clear-cut choice at the time, considering that the full cost of the works to be covered varied subsequent to the appointment of the subcontractor, and this could have affected the premium on forward cover. Secondly, the Rand is a widely fluctuating currency and any attempt to predict its future value is fraught with risks. A second option, the de facto scenario, was to make a budgetary provision to cover foreign exchange fluctuations and to minimise the risk of exposure through purchase of the bulk of the materials and payment in advance. The expected total cost of this foreign exchange exposure is R125 million for overseas-based subcontractors, bringing the total exposure to a not insignificant R190 million for the main contractor and selected subcontractors. This represents approximately 10% of the initial contract value.

What is referenced above as client ambivalence is a reflection on the City of Johannesburg internal organisation structure for project delivery. Whilst a special division was set up to manage the delivery of the 2010 World Cup infrastructure projects, a 'multi-layered' decision making structure denied the project director full powers in approving or disapproving design variations. Given the large scope of the project and the pace of site activities, delayed client approvals sometimes led to irreversible site situations.

The important lesson here is that the client organisation must be properly organised and empowered to run major projects. Expertise developed and achieved in the delivery of major projects must be retained for future projects.

### **Project-specific factors**

The new Soccer City stadium is retrofitted on an existing stadium. While this was expected to save on total project cost, it created unique problems for the design and construction processes and resulted in added costs. The rotation of the new design to fit onto the existing footprint was a costly challenge. On-site decisions made to improve the sight angle on the existing stands had financial implications, as was the decision to dismantle existing embankment seats in favour of new construction. Working on and around existing structures presented challenges for the protection of existing works. The movement of the heavy crawler crane for lifting of roof steel meant that existing access tunnels had to be significantly strengthened to avoid failure, at additional cost. The extent of alteration works has far exceeded what the initial design surveys disclosed, including discovery of unreinforced columns and demolition of unsafe portions of the existing structure, all for unbudgeted extra costs.

The important lesson is that the rush to deliver major projects with immovable use dates must not cloud the need for thorough pre-construction design and cost studies and risk appraisal. Failure to implement a meticulous approach could mean that uncertainty is not reduced over time in the process of project delivery.

## Macro-economic factors

Five new stadium projects and five refurbishment projects across the country commenced at about the same time period and for a world event scheduled for an unmoveable start date of June 2010. These projects commenced at a time of high levels of construction activity globally, with skills and critical material shortages worldwide. Combined with a rush to start on site even with incomplete designs, the scene was set for final project costs that would differ significantly from the norm achieved prior to 2007. With the benefit of hindsight, one approach could be for the construction of such series of major projects to be staggered across the country and commenced much sooner after the award of hosting rights in 2004.

## CONCLUSION

The sharp, upward movement of the Soccer City project cost is now reality. More detailed narratives on the causes of the cost escalation can be given retrospectively and the foregoing is a contribution. Reflectively, one could attempt to answer the key question: Was the cost escalation preventable? Most of the extra costs that have arisen are real costs with a portion being commercial adjustments for profit. Possible cost savings could have been achieved but on a different design. However, the prolonged construction period is unacceptable lapse on the part of the main contractor, pending claims notwithstanding. Lapses on the project management role contributed to mainly time-related compensation of the main contractor. Perhaps the genuine issue here is the extent to which the City ought to have known of its total financial exposure to this design of the Soccer City Stadium before the extra financial obligations became inevitable and irreversible.

An overarching lesson to be learned from the delivery of the Soccer City Stadium is that a complex project requires the investment of adequate time and effort to set up a project organisation that is prepared and empowered to apply the most rigorous approach to project management and construction management.

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# DISASTER PREPAREDNESS OF HIGH RISE BUILDINGS IN LAGOS METROPOLITAN AREA: EVALUATING THE RISK, VULNERABILITY AND RESPONSE STRATEGIES

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Although disasters can happen anywhere, certain types of disasters are more likely to occur in some buildings than in others; especially in those in urban areas. Buildings in Lagos have had nasty experiences from both natural and artificial disasters, claiming lives and properties in the past. This study aims at evaluating disasters and response strategies in high rise buildings of Lagos metropolis. Structured questionnaire was designed and administered to building owners, estate managers and disaster managers of the concerned high rise buildings to source for information. This was supplemented by interviews conducted with tenants, and rescue organizations. The study identified likelihood potential disasters, severity of impact, risk level, and achieved degree of preparedness to confront the disasters. The general status of response strategies was as expected, but there were still rooms for improvements. The threatening disasters were in the categories of acts of human and environmental whose vulnerability and impact were more severe on other properties than on the high rise buildings themselves. The magnitude of risk levels discovered could be contained with the already achieved response strategies if coordinated.

**Keywords:** high-rise-building, disaster, disaster- preparedness.

## INTRODUCTION

Disaster has been described as an extreme disruption of the functioning of a society: human life, livelihoods and property, that causes widespread human, material, or environmental losses (International Federation of Red Cross and Red Crescent Societies, 2000 ) usually exceeding the ability of the affected society to cope with using own resources (National Institute for Standard and Technology, 2008). Disaster in the perspective of Turnbull (2002) is a situation or impending situation caused by forces of nature, accident, intentional act or otherwise that constitutes danger to life or property. Buildings located in urban areas are likely to face disasters that are less likely to occur in rural areas (Chesapeake Virginia, 2010) and the effects are usually unique and worse in high rise buildings (10 floor and above) than in low rise buildings in the same locality. This may require sophisticated equipment and effective preparedness mechanisms to ward away or decrease severity of impact of the disasters (FAO/GIEWS, 2003).

The broad concept that describes the set of measures that can be used to minimise adverse effects of disaster is referred to as disaster preparedness (Standardization News, 2005) or alertness. This is achieved partially by putting in place readiness

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measures that expedite emergency response, rehabilitation and recovery (Chang et al; 2010). This may mean rapid, timely and targeted assistance to affected areas.

Comprehensive analysis, vulnerability assessment, response strategies and preparedness plan form basic activities of pre-disaster preparedness (Dilanthi and Richard 2010). The International Federation of Red Cross and Red Crescent Societies (2000) and The Hartford Loss Control Department (1999) outline a scope of the assessment to cover identification of disaster characteristics, frequency and potential severity, particular areas and communities that are most susceptible and vulnerable, as well as ability of these sectors to withstand and cope with the effects.

Waiting for events to occur is no longer a viable option and it is not enough to return hazard-hit communities to their frequently impoverished and vulnerable pre-disaster state (Chang et al; 2010). Further more; it is quite necessary to be prepared rather than adapting buildings.

The International Federation of Red Cross and Red Crescent Societies (2000) Viewed disaster preparedness to encompass the following objectives:

1. Increasing the efficiency, effectiveness and impact of disaster emergency response Mechanisms
2. Strengthening community-based disaster preparedness through National Society programmes for the community or through direct support of the community's own activity; and
3. Developing activities that are useful for both addressing everyday risks that communities face and for responding to disaster situations.

The research is limited to investigating risk, vulnerability and response strategies in disaster preparedness in high rise buildings.

## **METHOD**

Structured questionnaire was used to collect information from personnel of disaster management department, estate managers and or facility managers. Apart from the factors identified from literature, a pilot study was undertaken in a manner of independent interviews with prototype high rise buildings in different localities to supplement and rectify the questionnaire. The final designed questionnaire contains 48 factors which are regarded by literature and pilot study to have a potential influence on disaster evaluation, vulnerability and response strategies

The sampling frame contained 94 high rise buildings among which some were in groups, scattered all over the metropolitan area. In the questionnaire, the respondents were asked to rank the importance of each factor in achieving preparedness of pre-disaster on a five-point Likert scale from 1 to 5, where one symbolizes “not important at all” and five represents “very important” and levels of likelihood and severity of either low, medium and high point. The questionnaire also requested the informants to add any other potential factors and rate them accordingly. The questionnaires were sent by personal delivery by the researchers in field trips to 60 randomly selected high rise buildings or group of high rise buildings and 32 valid responses returned with the response rate of 53.3 percent.

Further interviews were conducted with user, rescue offers and owners of the buildings to whom questionnaire were served who contributed in the questionnaire phase. Within the interviews, qualitative data were captured around tenancy mix or profile of the high rise buildings and how they contribute to disaster risk or

preparedness; history of disaster occurrence and impact in each zone or area; and age of building and changes in use over time.

The interview sessions were voice recorded, transcribed, and coded. Quotes and comments from the interviews were confirmed and approved by the interviewees. A couple of these citations are presented in the paper as representative in regard to the specific subjects to help illustrate the points rose.

Certain geographic portions of a region are more prone to certain types of disasters, particularly those relating to natural disasters. Hence, the metropolitan was divided into four: Lagos Island, Victoria Island, Ikoyi and others (including Mainland, Ikeja, Isolo and the rest) according to location and nature of environment. Of the 53.3% of the high rise buildings covered, they were between 10-28 storeys and 79% of them fell between 10 to 40 years of existence. The assessment was carried out in accordance with outline standard methods (The International Federation of Red Cross and Red Crescent Societies, 2000 and National Institute for Standard and Technology, 2008) and the outputs were presented on table and charts.

## RESULTS

### Use and tenant mix of high rise buildings in Lagos metropolis

Although disasters could happen anywhere and at any time, certain types of disasters are more likely to occur in some buildings than in others one of the factors that could affect the vulnerability of a building to certain types of disasters is Tenant mix or residential profile (Turnbull, 2002). Buildings that are occupied by politically sensitive organizations and incompatible tenant mix- whether a commercial plaza also houses industrial tenants or simply business and mercantile establishments may influence vulnerability to disasters.

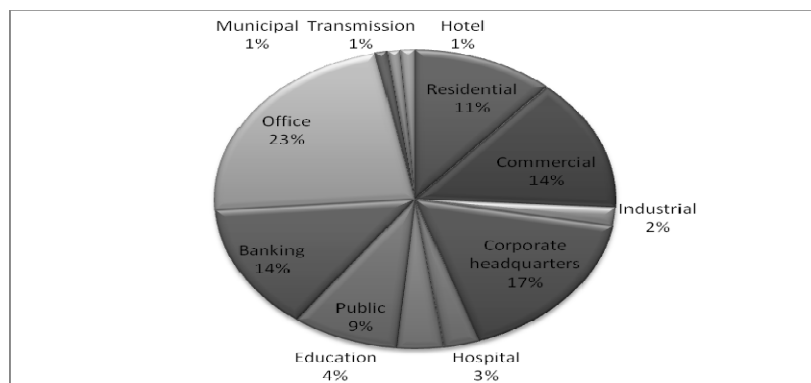


Figure 1: Tenant mix and uses of high rise buildings in Lagos

### Past disaster events

The differences and peculiarities of disasters occurring in high rise buildings is the levels of risks involve (Turnbull 2002). Hence, buildings in the same locality may be prone to different types of risk that demand different efforts to mitigate disasters. A lot of natural hazards can be foreseen, or anticipated, from past experience or from analysis of current patterns of land use. About 64.3% of Victoria Island respondents and 100% of the other areas of Lagos suggested that they had never been prone to disaster in the past and 57.1% Victoria Island and 100% of the other areas of Lagos were confident of further improved disaster situations. On Lagos Island there were mixed opinions regarding past disasters, only 14.3% did not experience disaster in the

past. However, 85.7% admitted improved situation over the years. Ikoyi was prone to disasters in the past but 100% admitted improvement over the years. The impacts of the past disasters had equal effects on buildings, lives, livelihood and other properties which did not show significant damage.

### Potential disasters and likelihood of occurrence

Some geographic portions of the metropolis were more prone to certain types of disasters than others, particularly those relating to natural disasters.

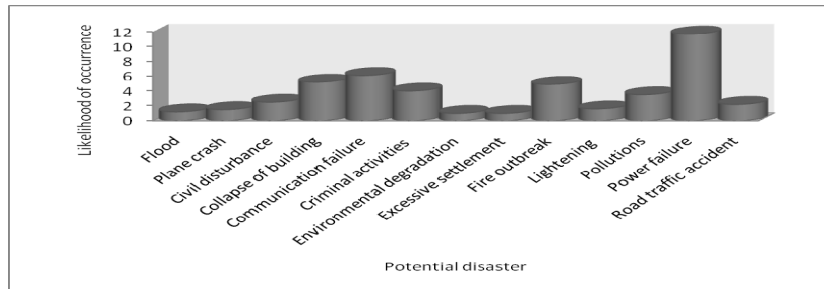


Figure 2: Likelihood of occurrence of disasters in Lagos Island

The identified potential disasters and likelihood of occurrence in the lagos Island is shown figure 2. The island is highly populated and is a commercial centre. It accomodates 42% of the high rise buildings.

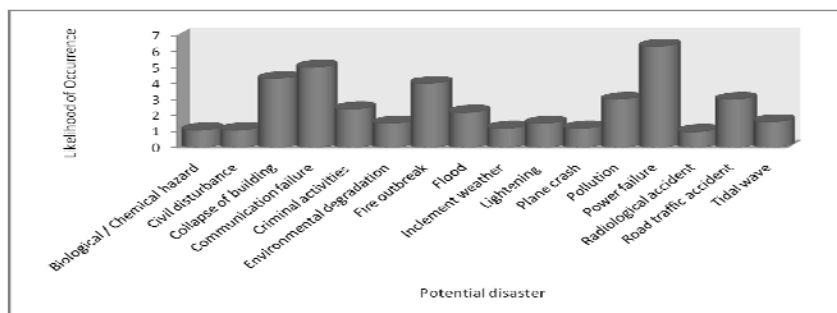


Figure 3: Likelihood of occurrence of disasters inVictoria Island

Figure 3 shows potential disaster identified and their likelihood of occurrence on the island of Victoria Island. About 37% of the high rise buildings are located on this island.

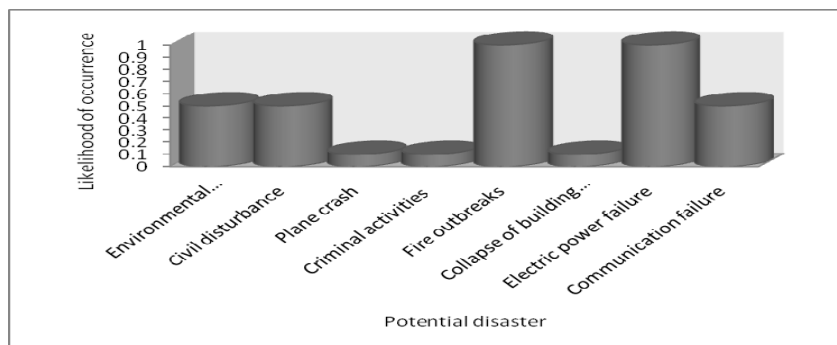


Figure 4: Likelihood of occurrence of disasters in Ikoyi

The likelihood of occurrence of disasters at Ikoyi area is presented on figure 4. There are few high rise buildings in this relatively thin populated area.

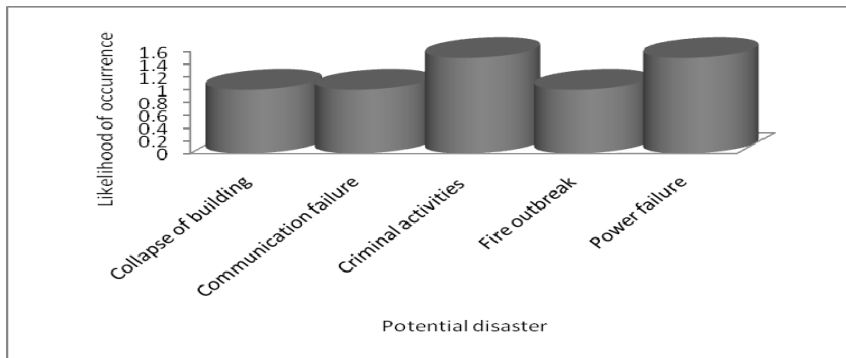


Figure 5: Likelihood of occurrence of disasters in other areas of Lagos.

Figure 5 shows the likelihood of disaster occurrence for other areas of the metropolitan. The rest of the metropolitan areas house fewer high rise buildings. They account for 8.5% of the high rise buildings.

### Severity of disasters

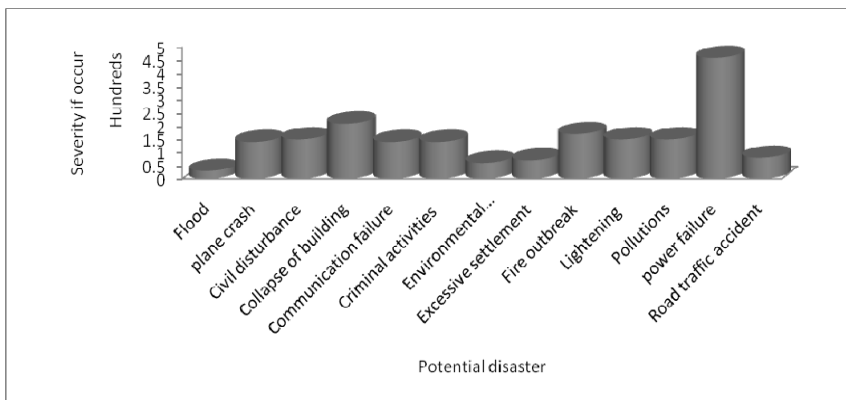


Figure 6: Severity of impact of anticipated disasters in Lagos Island

The anticipated severities of impact of the potential disasters for Lagos Island are presented on figure 6. Within the highly populated island, 13 disasters were found to have significant impacts if allowed to occur.

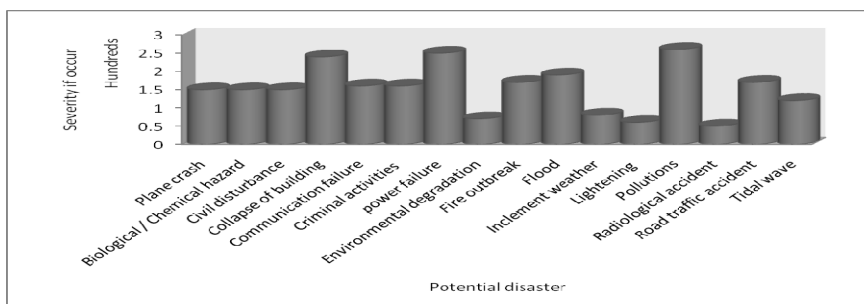


Figure 7: Severity of impact of anticipated disasters in Victoria Island

The probable severities of impact of disasters are presented on figure 7. Sixteen disasters sources were peculiar to this area.

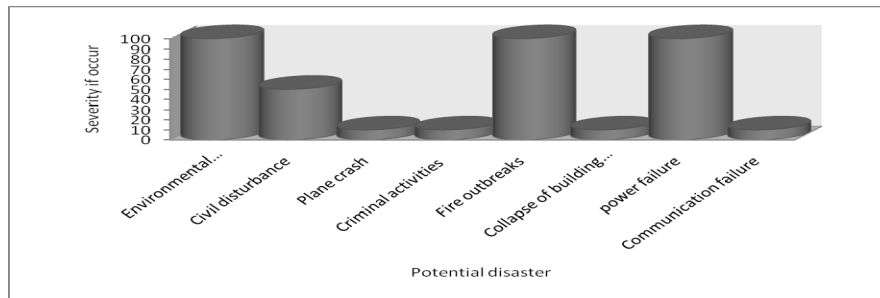


Figure 8: Severity of impact of anticipated disasters in Ikoyi

Severities of eight disaster sources likely to occur at Ikoyi are shown on figure 8.

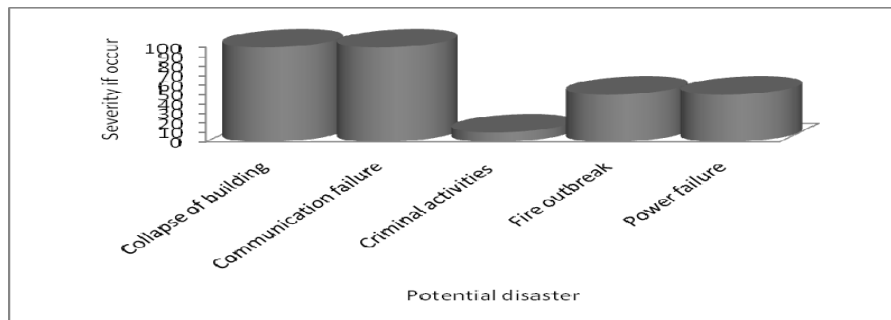


Figure 9: Severity of impact of anticipated disasters in other areas of Lagos

Severities of the disasters likely to occur at other areas of Lagos are shown on figure 9. Fewer disaster sources were prone to this wide area of the metropolitan.

### Disaster vulnerable areas

The potential for a threat-source to successfully exercise a particular vulnerability is a weakness that can be accidentally triggered or intentionally exploited. A threat-source does not present a risk when there is no vulnerability that can be exercised (The International Federation of Red Cross and Red Crescent Societies, 2000).

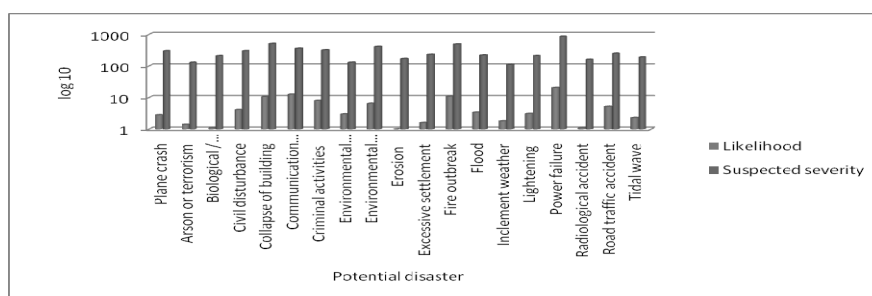


Figure 10: Likelihood of occurrence and anticipated impact of disasters in Lagos metropolitan

The structural vulnerability of the high rise buildings, other properties and neighborhood present the likely of damage or disruption while human vulnerability indicate relative lack of capacity of a person or community to cope with or resist the impact of the disaster hazard.

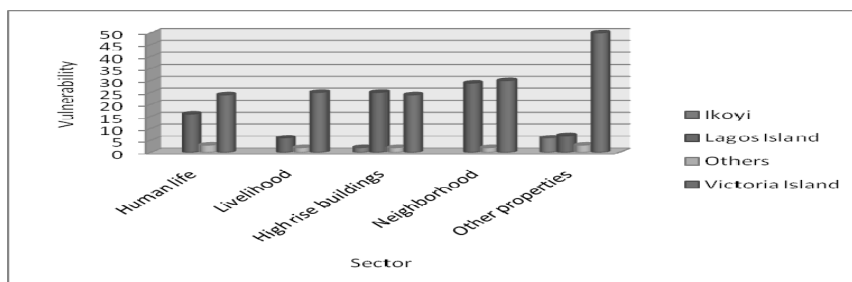


Figure 11: Anticipated areas of vulnerability in Lagos metropolitan area.

### Disaster risk levels

To derive an over all likelihood rating that showed probability that a potential vulnerability might be exercised within associated environments, effective implementation of disaster response plans must be considered. This implies that vulnerability is not likely to be exercised or the likelihood is low if there is low level of threat-source or capability or if there are effective response that can eliminate or reduce the magnitude of risk. The risk levels of a particular threat and vulnerability are shown in Table 1.

Table 1: Disaster risk levels for high rise buildings in Lagos metropolitan areas

S/no	Disaster	Lagos Island	Victoria Island	Ikoyi	Others
1	Flood	L	H	L	L
2	Inclement weather	M	M	L	L
3	Arson or act of terrorism	M	L	L	L
4	Tidal wave	M	M	L	L
5	Earthquake / tremor	L	L	L	L
6	Lightening	H	L	L	L
7	Landslide	M	M	L	L
8	Mud flow	M	L	L	L
9	Erosion	L	L	L	L
10	Cyclone	L	L	L	L
11	Tornadoes	M	L	L	L
12	Environmental degradation	H	L	H	L
13	Excessive settlement	H	M	L	L
14	Radiological accident	M	L	L	L
15	Hurricane	L	L	L	L
16	Civil disturbance	H	H	L	H
17	Biological / Chemical hazard	L	H	L	L
18	Road traffic accident	H	H	M	L
19	Environmental pollution	H	H	L	L
20	Chemical Explosion	L	M	L	L
21	Plane crash	H	H	L	L
22	Criminal activities	H	H	L	L
23	Fire outbreaks	H	H	H	L
24	Collapse of building	H	H	L	M
25	Power failure	H	H	H	H
26	Communication failure	H	H	L	L

H = High; M = Medium; L = Low. (On risk scale of the National Institute of Standard and technology, 2008)

### Response strategies and mechanisms available to cope with disasters

One of the factors that increase vulnerability to disaster is lack of knowledge about how to effectively resist the effects (Standardization News, 2005). Preparedness

mechanisms and strategies enhance and increase effectiveness of response (The International Federation of Red Cross and Red Crescent Societies, 2000) to disaster. The relevant strategies include development of issues required for response to disaster. The degrees of attainment or perfections (in percentage) in developing of each of the issues are summarized in table 2.

Table 2: Achieved response preparedness in the high rise buildings

S/no	Response strategies	poor	Fair	Good	Very good	Excellent
		Percentage				
1	Developed Evacuation procedures	3.2	25.0	40.6	15.6	15.6
2	Trained search and rescue teams	18.8	21.9	28.1	31.2	0
3	Disaster assessment teams	6.7	26.7	30.0	23.3	13.3
4	Assessment process and information priorities	6.5	29.0	29.0	25.8	9.7
5	Measures to activate special installations	22.6	38.7	19.3	9.7	9.7
6	Procedures for activating distribution systems	22.5	32.3	32.3	9.7	3.2
7	Preparations for emergency reception centres	21.9	18.8	40.6	15.6	3.1
8	Procedures for activating emergency programs	22.6	12.9	51.6	6.5	6.4
9	Prepared storage and rapid acquisition of facilities	9.4	40.6	31.3	12.5	6.2
10	Developed emergency preparedness plans	3.2	29.0	45.2	16.1	6.5

## DISCUSSION

The major use and tenant mix of the high rise buildings in Lagos is shown in figure 1. Use for office purposed amounted 23% followed by corporate headquarters, banking and finance and commercial tenancy with 17%, and 14% respectively. Each of the buildings had multiple uses.

To assess disaster-source, the National Institute of Standards and Technology (2002) recommended considering all sources of disasters even if likelihood of occurrence may be insignificant. The likelihood of disaster for each one of the zone is represented in figures 2 to 5 and the likelihood ratings imply probability of potential vulnerability that may be exercised within the environment. Potential disasters and likelihood of occurrence for Lagos Island (figure 2) suggests that power failure has the highest source of disaster ahead of collapse of building structures and communication breakdown. Criminal activities and fire out break were also significantly high. Figure 3 present the disaster situation in Victoria Island. Power failure, fire out break, collapse of buildings and communication break down were the major likely sources disasters. The next likely significant sources were environmental pollutions, road traffic accident, flood and criminal activities. In fig 4, fire out break and power failure were more likely to occur in Ikoyi. Plane crash, criminal activities and collapse of



buildings had the least probabilities of occurrences. Figure 5 shows the likelihood of disaster occurrence for other areas of the metropolitan where little or no disaster was identified to involve high rise buildings, depicting the situations in the past. All of the few disasters that could occur had slim chances of occurrences.

The anticipated severities of impact of potential disasters in Lagos Island are reported in figure 6. Power failure had highest probability of severity if occurred

In the Victoria Island, the disasters with highest point of severity were collapse of building structure, power failure and environmental pollutions while the least severe ones were road traffic accident and environmental degradation (fig 7). Figure 8 shows the severity of potential disasters at Ikoyi. Disasters with most severe impacts were environmental degradation, fire out break and power failure. Collapse of buildings, failure in communication, criminal activities and plane crash were relatively having minimal severities. Severity of disasters that were likely to occur at the other areas of Lagos is shown on figure 9. Collapse of building structures and communication break down had the highest severities of impact while criminal activities had the lowest. In a summarized form, the entire metropolitan area had power failure, fire out break, communication failure and collapse of buildings as the most highly likely disasters to occur and could have high impacts. Disasters such as road accidents, excessive settlement, biological or chemical attack, and terrorism would have weak impacts

At disaster onset, some sectors had the tendencies of resisting and coping better with disasters than others. Figure 11 summarises the vulnerability of different aspects of the sectors to anticipated disasters. The figure suggests that properties other than human lives, livelihood, and neighborhood tended to be safer in Victoria Island than in Ikoyi.

The risk levels; which functions as likelihood of disaster source, magnitude of impact should a disaster successfully hit and adequacy of plan for reducing or eliminating risk, for Lagos metropolis is shown in table 1. In the table, the two Islands hold majority of potential natural, environmental and man made disasters. About 86% of the high rise buildings are situated on these Islands. The 14% located in the less dense areas of Ikoyi and the rest of the other areas of the metropolitan faced fewer threats. High and medium disaster risk levels suggested corrective action plans be put in place as soon as possible whereas low risk levels gave the options to either determine whether corrective actions were still required or decided to accept the risk (National Institute for Standard and Technology, 2008 ).

The percentage preparedness among the high rise buildings in Lagos metropolitan area showed in table 2. The table presents a wide range of degrees of readiness to combat the anticipated hazards tabulated in table 1. Provisions of evacuation procedures in event of disaster onset were mostly attained as expected (40.6%) and even somewhat better than were expected to be in place while assessment of process and information priorities for response to disaster in the buildings was somewhat between worse than expected ( 29%) and good (29%). Efforts on development of emergency preparedness plans, processes and procedures was 45.2% achieved whereas measure to activate special installations like mobile hospital facilities and procedures for activating distribution systems were somewhat worse than expected with 38.7% and 32.3 % scores respectively. The availability of disaster assessment department to identify disasters, their likelihood, vulnerability and impact was somewhat worse than expected (26.7%) to good (30.0%). Presence of search and rescue teams at their disposal was very good (31.1) contrasting stage of preparations

for storing or making arrangements for rapid acquisition of facilities which was 40.6% worse than expected. Endeavor in the preparation for emergency reception centres and shelters and a procedure which activates emergency programmes for transportation were as expected, with 40.5% and 51.6% respectively.

## **CONCLUSION**

Similar to the historical events of disasters in the metropolitan area, the potential disasters and their likelihood of occurrences remained few and limited. The threatening disasters were in the categories of acts of human and environmental whose vulnerability and impact were more on other properties than the building themselves. The magnitude of risk levels envisaged could be contained within the frame work of the already achieved of response to the disasters if the efforts could be coordinated. The general status of the response strategies were as expected but there were needs for further improvements.

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# EFFECTS OF FLOODING ON THE BUILT ENVIRONMENT IN AKURE, NIGERIA

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Flood is a devastating phenomenon aided by man's actions such as waste dump and construction on river channels without adequate consideration to specified setbacks from the river. Poor consciousness of the inhabitants on the environmental information and inadequate spatial information on the flood prone areas has also contributed to compound the annual problem of flooding. Floods do not only damage property and endangers human and animal lives, it also have some other devastating effects on the environment as well. Sewer outfalls, bridge abutment, bank lines, and other structures within floodway are usually damaged. Navigation and hydroelectric power are also often impaired. The researchers review existing literatures and carry out a field survey of the affected areas in Akure, the capital of Ondo State in Nigeria. This paper seeks to assess the seriousness of the problems posed by floods to the built environment by examining its major causes and devastating effects. It postulates likely short and long term solutions to the problems, stressing the need to stipulate and enforce relevant environmental laws regarding the setback of building from river banks. It concludes by emphasising the need to sensitise people from dumping refuse along river path.

Keywords: flooding, refuse disposal, built environment, flood plain.

## INTRODUCTION

This paper focuses on the effects of flooding on the built environment in Akure, the Ondo State Capital. Flood is the overflow of a river or the temporary rise in the level of the sea or a lake which results in the inundation of dry land (Gareth et al, 1990). It is an overflow of water onto land that is normally dry. A river flood is caused by the inability of these water bodies to accommodate an increase supply of water. Floods occur when peak discharge exceeds capacity; and this may be brought about naturally by intense precipitation or by failure of man-made structures, by deforestation, urbanisation, which reduce infiltration and interception, and by engineering works, such as land drainage and straightening and embankment of meadow areas in which to divert flood water, and a ban on building in flood-prone environments, such as flood plain (Brett, 1993). According to Amodeni (2005) flood is defined as large volumes of water in places that is usually dry and that flood occur when abnormal large quantity of water that cannot be accommodated within the channel is supplied to the area that is not usually under water. Urban-scale floods usually damage soil and crops and affect important ecological areas, killing people and rendering the people homeless (Okecha, 2000).

Arayela (2008) defined the built environment as “man-made surroundings that provide the setting for human activity, ranging from the large-scale civic surroundings to the

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personal spaces”. In general context, built environment refers to all buildings, and spaces between them such as streets and squares as well as civil and mechanical engineering works such as roads, drainages, sewage disposal, plumbing and so on.

This research study’s the empirical cases of flood incidence in the study area using survey and questionnaire means with the view of proffering long term solution to the incidence of flooding in the built environment and suggesting ways of improving the built environments in Nigeria in general and Akure in particular.

## **STATEMENT OF THE PROBLEM**

During rainstorm, water on the surface of the earth evaporates, infiltrates, or remains in depression storage. Some water would be intercepted by vegetation and paved surfaces such as roofs and roads. When rain intensity is less than the infiltration capacity, the water infiltrates into the soil and percolates to join the underground water. During prolonged storm, when soil capacity is satisfied, surface runoff takes place, which washes away the top soils and termed erosion. In a built environment, large areas are occupied by buildings and paved surfaces resulting in increased peak storm discharge. When natural and artificial channels are adequate, the water from surface runoff is discharged into streams, if they are inadequate or blocked, overflowing results and damage to lives and properties occurred.

The existing drains may face the problem of inadequacy in terms of design and construction or lack of maintenance and indiscriminate dumping of refuse into it. These factors may further compound the problem of flooding, leading to destruction of lives and properties. Fadairo (2000) observed that Akure urban area has suffered serious flooding on many occasions especially whenever Ala River covers its low-lying areas.

In Akure, urban conditions exacerbate drainage problems, run-off increased by impermeable urban surfaces and due to inadequate development control mechanisms and their incompetent enforcement, settlements are constructed with little consideration for storm water drainage.

Areas that fall within the floodplain of Ala River in Akure experienced uncontrollable floods when it reaches its high-water stage in which water overflows its natural or artificial banks onto normally dry land, such as the river inundating its floodplain to cause considerable damage commonly resulting from excessive rainfall in a brief period in the study area where there is no common measures of flood control, including improved channels, storage reservoirs, soil and forest conservation programs to retards and absorb runoff from storms.

Unfortunately, all rivers in Akure have their courses around areas where population has expanded rapidly which, in many cases, are the poorest area in the town with poor roads and drainages (Olanrewaju and Fadairo, 2003). Apart from the high rate of the town growth, previous planning administrations neglected the planning of the town in relate to flood prevention as a result, the situation has reached an alarming stage that deserves serious approach in order to sustain and preserve the architecture, structure and the beauty of the town.

## **HYPOTHESES**

Within the context of this study, the null form of hypothesis will be used. The null hypotheses of the study are:

H1: Setback of buildings from the river has no significant influence on flooding in the study area.

H2: Mode of waste disposal has no significant relationship with the causes of flood in the built environment.

H3: Frequency of flooding occurrence has no significant effect on the quality of the built environment.

## RESEARCH DESIGN

For statistical analysis, this study primarily relies on the data collected by Fadairo (2008) in a PhD research on the “Impact of Flooding on Urban Housing: A Focus on Ala River in Akure, Nigeria”. The survey was carried out on the entire flood-prone area of Ala River and its tributaries in Akure using close-ended questionnaire.

The survey sought to obtain an infrastructural asset profile assessing past experience and perception of flood hazard by the inhabitants of the flood plain, household damage, and flood effects upon property and household members. This was supported by preliminary site observations, informal discussions with residents and a post-survey check through in-depth interviews conducted with the inhabitants of the area. In the research a total number of 440 questionnaires were administered at random to one adult respondent per household in the study area. Among the variables examined are:

- Types of building.
- Building floor finish level.
- Mode of household waste disposal.
- Building setback from river.
- Frequency of flood occurrence.

The population of this study was the entire inhabitants of the flood-prone areas of Ala River and its tributaries in Akure. There are four floodplains for study in the areas which are:

1. Oshinle/Ijoka Road area;
2. Oke-Aro/Odi Olowo/Arakale/Adesida Road area;
3. Oyemekun Road area; and
4. Isolo/Araromi/Oke-Ijebu area.

Table I shows the percentage of distribution of questionnaires in the study area.

Table I: Percentage of distribution of questionnaire in the study area

Zone	Area	No of houses	Percentage
A	Oshinle/Ijoka Road	90	20.5%
B	Oke-Aro/Odi-Olowo/Arakale/Adesida Road	97	22.0%
C	Oyemekun Road	88	20.0%
D	Isolo/Araromi/Oke-Ijebu	165	37.5%
TOTAL		440	100%

Source: Fadairo, 2008

## RESULTS AND DISCUSSION OF FINDINGS

**Building Type:** There are five major types of buildings in the study area, namely: roomy apartment (face-to-face house), detached bungalow (self-contained house), semi-detached bungalow, storey building and duplex. As shown in table II, data obtained shows that roomy apartments lead with 53.6%, followed by storey buildings 26.6%, detached bungalow 15.5%, semi-detached bungalow 2.7% and duplex 1.6%. From this analysis, it is evident that roomy apartments are more common in the housing typology of the study area. This could be due to cost of construction, high return on rent and low level of technology required.

Table II: Types of building in the study area

Building Type	Frequency	Percentage
Roomy Apartment	236	53.6
Detached Building	68	15.5
Semi-Detached Building	12	2.7
Storey Building	117	26.7
Duplex	7	1.6
Total	440	100

Source: Fadairo, 2008

**Building Floor Finish Level:** From the data obtained (Table III), 22.7% of the buildings floor finished level was below natural ground level. Other buildings in the study area have 33.2%, 21.8%, 11.8% and 10.5% as built in relation to 150mm, 300mm, 450mm and 600mm above natural ground level respectively. Since water flows in relation to natural slope, it is evident that whenever it rains in Akure, all the buildings below ground level floods.

Table III: Building finished floor level in the study area

Building Finished Floor Level	Frequency	Percentage (%)
Below natural ground level	100	22.7
150mm above natural ground level	146	33.2
300mm above natural ground level	96	21.8
450mm above natural ground level	52	11.8
600mm above natural ground level	46	10.5
Total	440	100

Source: Fadairo, 2008

**Mode of Household Waste Disposal:** As evident in table IV, only 58.6% of the houses in the study area collected their waste in dustbin and pass it on to Waste Management Agencies while 14.1% throw their waste to drainage channels. Only 1.6% burns their waste in incinerator and the remaining 25.7% left the waste in the surrounding buildings and allow it to spill all over the environment. Inability to effectively remove and manage waste is evident from this analysis and account for frequent blockage in the drainage channels and dirty environment.

Table IV: Mode of household waste disposal in the study area

Mode of Waste Disposal	Frequency	Percentage (%)
Thrown into drainage channels	62	14.1
Collected in dustbin	258	58.6
Burnt in incinerator	7	1.6
Others	113	25.7
Total	440	100

Source: Fadairo, 2008

**Building Setback from River:** The study shows, as indicated in table V that 40.7% of the buildings observed 25-36m setback to the river, 17.5% observed both 19-24m and 13-18m each, 14.8% observed 7-12m and 9.5% observed less than 6m setback from the river. It is evident from this analysis that majority of the buildings in the study area do not observed the minimum setback from the river thereby making them susceptible to regular flooding each time the river overflows it channel.

Table V: Buildings setbacks to river in the study area

Building setback to river	Frequency	Percentage (%)
Below 6m	42	9.5
Between 7-12m	65	14.8
Between 13-18m	77	17.5
Between 19-24m	77	17.5
Between 25-36m	179	40.7
Total	440	100

Source: Fadairo, 2008

**Frequency of Flood Occurrence:** The study shows, as evident in table VI, that flood occurrence at the raining season peak has 49.5% whereas it is 36.6% anytime it rains and 13.9% at any raining season. This indicates that people that rent houses in the flood-prone areas of Akure vacate the area during rainy season while there is always availability of houses for rent during the dry season in the study area.

Table VI: Frequency of flood occurrence on the study area

Flood occurrence rate	Frequency	Percentage (%)
Every raining season	61	13.9
Every raining season peak	218	49.5
Every raining day	161	36.6
Total	440	100

Source: Fadairo, 2008

## SUMMARY OF FINDINGS

From the study findings, it is clearly shown that cost of construction, available technology and ease or rate of construction as well as expected financial benefits dictates the type of buildings. A sizable percentage of the buildings in the study area have their floor level below the natural ground level account for easy flooding anytime it rains. The problem of waste disposal and management is also clearly

evident as majority of the residents in the study area does not patronise or have access to waste management agencies cause them to dispose off their waste indiscriminately, especially on the available drainage channels leading to blockage of these channels and subsequently resulting in flooding. Specified setback from rivers was not observed by the majority of the building owners in the study area as buildings were built within the setback making them susceptible to flooding whenever the river overflows its bounds. Because of these, the rate of flood occurrence in the study area is evidently high during the raining season forcing most of the residents to abandon the buildings during raining season and causing enormous damage to properties and threat to lives.

## **RECOMMENDATIONS**

In view of the above findings, the study therefore recommends as follows:

In the short term, that there is an urgent need to channelize Ala River so as to allow easy flow of the River.

That there is an obvious need to educate the people on flood plain, areas prone to flood, effects of flood on the built environment ranging from health hazard of the people to wanton destruction of properties. Residents should be educated on the advantage of raising their buildings above adjacent road level, observing minimum setbacks from rivers and roads, provision and maintenance of drainages and proper ways of disposing their wastes.

Government should stipulate, publicise and enforce all relevant environmental laws regarding building setbacks from roads, rivers, high tension wires, etc and waste collection and disposal. The Waste Management Agencies should be alert to their responsibility by ensuring that they cover all the nook and cranny of the city to collect waste and dispose them appropriately.

Government should ensure that adequate networking of basic infrastructure such as drainage, water, electricity, etc are provided before an area is approved for development.

## **CONCLUSIONS**

It is clear that the three null hypotheses examined in this study show significant relationship between the two variables in each case of the hypothesis, thus confirming the validity of the research findings. The negative and damaging effects of flood on the built environment cannot be oversized, hence the need to sensitise people to avoid any act that can lead to flooding such as indiscriminate building and dumping of refuse along river path.

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# EMPHASIZING THE NEED FOR ESTATE SURVEYORS AND VALUERS' CAPACITY BUILDING IN HOUSING DEVELOPMENT IN MEGA CITY

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As of December 2009, the earth's population is estimated by the United States Census Bureau to be 6.802 billion, 3.2 billion of people live in urban areas - this is half of the total world population. As at today there are 25 mega cities in the world with Lagos as the 25<sup>th</sup>. Housing the poor in the mega cities of developing world is one of the major challenges facing mankind. Global capital has transformed local property market practices. To capture this market effectively and relevantly, Real estate professionals have to re-orientate themselves so that they can move up the service value-ladder and avoid being marginalized under intense competition in the mega city housing development. Re-orientation of professional practices involves an expansion of one's geographical and market knowledge beyond the home boundary. It also requires a dramatic change of mind-set, work attitude, social awareness and lifestyle. Sampling the opinions of Estate Surveyors and Valuers in Nigeria, preliminary findings revealed low entrepreneurial competencies among Real Estate practitioners. 100% of the sampled Real Estate firms have access to computer, 27% have access to specific Real Estate software, 18.5% organises refresher courses for staff. During the course of survey, creativity among Estate Surveyors stood at 23% while 33% demonstrated ability to set and achieve ambitious goal. While all the sampled Estate surveyors agreed to have relevant roles to play in housing development, only 41% are playing key roles. This paper concludes by recommending measures geared towards developing the competence needed for effective participation of Estate Surveyors in housing development of our mega cities.

Keywords: capacity building, estate surveyor, housing development, mega city.

## INTRODUCTION

As of December 2009, the earth's population is estimated by the United States Census Bureau to be 6.802 billion, 3.2 billion of people live in urban areas - this is half of the total world population. According to predictions by the United Nations. By 2030, over 60% of people will live in cities.

The megacities listed by the UN already have a total population of around 280 million. They are increasingly the growth engines of their respective national economies. But as these cities and economies grow, so do the challenges. One key issue is the burden that growth is placing on urban infrastructures. Urban residents the world over want and deserve a good quality of life. They need good air to breathe, good water to drink and reliable electricity to power their lives. People need healthcare. They also need to be mobile so transportation systems must be capable of transporting millions of people while putting as little strain as possible on the environment and city budgets. In other words, a good quality of life requires a well-

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functioning infrastructure. In response to infrastructural development, professionals in the built environment have a great role to play. Estate Surveyor and Valuer base on his diversified intellectual capacity has a key role to play. It is within this analytical context that this paper examines the quality of the Estate surveying and valuation practice in Nigeria by measuring Estate Surveyors and Valuers capacity geared towards developing the competence needed for effective participation of Estate Surveyors in development of our mega cities.

## **MEGACITY-A GLOBAL PERSPECTIVE**

A megacity is a status conferred by the United Nations and the international system on cities with 10 million persons and above. It is a city with complex functions, and with ability to influence regional and global economies.

Rates of urban growth are expected to remain relatively high over the next 25 years, with marked increases in the urban population of both continents and of the world. In 1950, 14.7 percent of Africa's inhabitants were urban, in 2000 it was 37.2% and by 2015 it is expected to rise to 45.3 percent. UN studies indicated that by 2005, half of the world's population lived in urban areas, a huge jump from the 30 percent living in urban areas in 1950. Some 3.2 billion of the world's 6.5 billion people live in cities today, and the number will increase to 5 billion- an estimated 61 percent of the global population by 2030 (UN Commission on Population and Development). In the cities, where most resources will be consumed, and most pollution and waste will be produced, nearly all of the expected increase in the world's population will occur in developing countries. Current patterns of urban development and human activity have led to environmental degradation, and have created a threat to continued human existence, and to the sustainability of life on earth. It is possible to make the cities more liveable through effective planning.

## **INFRASTRUCTURAL CHALLENGES OF MEGACITY**

The challenges of any megacity are enormous. For the sake of this paper, infrastructural challenges will be considered thereby emphasizing the need for the intervention of government, private sector, infrastructural providers and professionals in the built environment. Estate Surveyors and Valuers as a key player and link with all other professionals in the built environment have very relevant role to play. Globescan and MRC (2004) in their work identified the infrastructural challenges of mega city to include

Transportation, Electricity, Water and waste water, Safety and Security Similarly, George (2010) highlight the challenges of Lagos as a mega city to include Urban Sprawl, Encroachment on Conservation Zone, Inadequate Basic Infrastructure and Communal Facilities, Inadequate Energy (Electricity), Inadequate Potable Water, Formation of Slums, Urban Road Transport Problems, Urban Traffic Congestion, Municipal Waste Management, Urban Violence, Change of Use / Illegal Development, and Impact of Industries.

In tackling these problems, basic challenges in Nigeria's urban management include inadequate professional and supporting technical staff as well as inadequacy of current digitized data and information on urban conditions. Effective urban management strategies depend on comprehensive and up to-date information base. Shien (2008) identified Shortage of qualified man power as a major threat to city development. The shortage of qualified and experienced tradesman or artisans who are the main pivot in the Nigerian building industry has continued to increase (Taylor, 2000, Babatunde,

2003). There is a growing apathy towards technical/vocational education and a collapse of the apprenticeship system where competent personnel are being produced. Agbola(1998) believed that the lack of prestige for technical education, and the lack of competent teachers in technical education and decline of the apprenticeship system all have produced a poorly performing construction sector; where winning a contract and mobilization fees becomes the key to wealth, not housing production.

The current state of building collapse in Nigeria today might not be unconnected with this problem.

The inadequacies in our land professionals is a major factor for the under development of Real Estate sector in Nigeria. Adediji (2009) opined that the real estate sector in Nigeria is grossly under-developed, lopsided in distribution, bedeviled by imperfect market and shrouded in secrecy.

Today, only Lagos, Abuja, Port Harcourt and a few other state capitals can boast of appreciable real estate investment market and products.

Estate Surveyors and Valuers are land economists, hence, the engine room of the nation's land resources management and utilization. It is incumbent on us therefore to be deeply involved in the formulation and implementation of rules, regulations, policies and laws that affect the use, planning and development of land.

Babatunde (2005) in his work captured the general definition of Estate Surveying and Valuation as the act, science and practice of:-

Determine the value of all description of property and of the various interests therein.

Managing and developing estates and other business concerned with the management of landed property.

Securing the optimal use of land its associated resources to meet social and economic needs.

Determining the structure and condition of buildings and their services and advising on their maintenance, alteration and improvement.

Determining the economic use of land resources by means of financial appraisal for the building industry and

Selling (whether by auction, or otherwise) and buying or letting (as an agent) of real and personal property and any interest therein.

In making Estate Surveying and Valuation profession relevant, The Nigerian Institution of Estate surveyors and Valuers (NIESV) shall have the following objects namely:-

To establish a high and reputable standard of profession conduct and practice in landed profession throughout the Federal Republic of Nigeria.

To secure and improve the technical knowledge which constitutes land economy including the valuation or appraisal of real estate and such fixture and fittings thereto including Plant and Machinery Land Management Development Investment and Town Planning and to facilitate the acquisition of such knowledge by working in close collaboration with Universities Institutions of Higher Learning and other professional bodies.

To promote the general interests of the profession and to maintain and extend its usefulness for the public good by advising members of the public Government Department Statutory Bodies Local Governments Associations Institutions and such

like bodies on all matters coming within the scope of the profession and to initiate and consider any legislation relevant to the objects of The Institution.

To endeavor to acquaint the public with the role of the Estate Surveyor and Valuers in the economic development of the country

The question is: to what extent has the profession establish a high and reputable standard of profession conduct and practice in landed profession throughout the Federal Republic of Nigeria?

## **ROLE OF ESTATE SURVEYORS AND VALUERS IN DEVELOPMENT OF MEGA CITY**

The role of Estate Surveyors and Valuers in development of mega city is not different from the traditional roles in developing cities. However, development of mega city is more demanding requiring high level of professionalism and capacity. In view of this, the role of Estate Surveyors and Valuers in development of mega city include

**Policy Formulation:** Going by the huge demand of mega city, new and existing government who want to record landmark are usually faced with unclear possible course of actions and as such require the service of professionals like Estate Surveyors and Valuers to present recommendations on certain aspects of mega city development. These recommendations usually form the basis for policy formulation in mega city development.

**Funding Arrangements:** Finance is a major challenge in funding developmental project in mega city. Estate Surveyor and Valuer base on his diversity plays a key role in arranging fund by recommending alternative Real Estate Funding that is adequate with specific reference a particular mega city. A sub key role is to ensuring that at every point of negotiation with funding partners, the interest of government is protected.

**Development:** Estate Surveyors and Valuers role in the actual development is crucial. These include Development appraisal, property taxation, Valuation, compensation, Arbitration, Environmental management and Monitoring/evaluation.

**Post Development/Management:** Estate Surveyors and Valuers role in post development/management of mega city is as important as the actual development if developed projects are to be sustained. It has been severally argued that we lack maintenance culture in Nigeria. There is need to fully integrates the service of Estate Surveyors and Valuers in Managing mega city in the area of facility management, waste management, change in land use that is value driven, land allocation, Land information system, Rent/rates collection among others.

## **ASSESSMENT OF CAPACITY OF ESTATE SURVEYORS AND VALUERS IN NIGERIA IN THE MANAGEMENT OF MEGA CITY**

As at today (March 2010) there are 2385 registered Estate Surveyors and Valuers in Nigeria. These professionals are expected to attend to the Real Estate needs of over 150 million Nigerians at ratio 1:62893. This work is not intended to analyse this ratio further. However, it is the concern of this work to examine the effectiveness of Estate Surveyors and Valuers in response to the development of megacity.

In assessing the effectiveness of Estate Surveyors and Valuers, 250 Estate Surveyors and Valuers were randomly selected across the country. Findings during the course of research are discussed below.

**Professional Registration:** All the respondents are professional members of Nigerian Institution of Estate Surveyors and Valuers (NIESV) and duly registered by the Estate Surveyors and Valuers Registration Board of Nigeria (ESVARBON).

**Office Equipments/Tools:** 79% of the respondents are working in Estate Surveying and Valuation office. Findings revealed that all the respondents have office accommodation from where they operate. All the respondents are having access to computer system. Investigation reveals further that specific Real Estate software applications are not common among practicing Estate Surveyors and Valuers as only 27% of the respondents attested to the use of Real Estate software. This is worrisome in the light of the dynamic technology growth and change that characterize the business world. In megacity development going by the high population, volume of data to be handled is usually large, valuation are rampant, feasibility and viability studies are high in demand, developmental projects are on the increase. Relevant sophisticated Real Estate software will go a long way in giving efficacy to Real Estate practice.

**Staff strength:** The chief executive officer/officers of the sampled Estate Surveying and Valuation Firms are qualified Estate Surveyors and Valuers. The caliber of other staff of the firms is a thing of concern. Further findings reveals that big Estate firms which forms about 13% of the respondents parade graduates of Estate Management with staff strength of 4 and above. Only 21% of these graduates are professional members of NIESV. Medium scale firms have between 3 and 4 graduates of Estate management while small scale Estate Firm parades below 2 graduates, ordinary national diploma holders, SIWES students and NYSC Staff as main staff.

**Staff efficiency:** Findings revealed that most Nigerian Estate Surveyors and Valuers have the strength to work for long hours and under stress. It is however worrisome that few of these professional possess the robust intellectual base. Less than 50% are proficient in the use of computer. Only 8% can effectively use computer aided design, excel for calculation and other planning software. Less than 3% can apply GIS to Real Estate Practice

**Entrepreneurial Skill:** while the driving force of Estate Surveyors and Valuers in Nigeria is appreciated, there are times when majority are not involve in any major brief. This bothers on the low entrepreneurial characteristic of Estate Surveyors and valuers in Nigeria. The Real Estate sector is rich, it is therefore expected of practitioners to be guided by marketing and business skill in their practice. Non-professionals (quacks) are eager to take advantage of these vacuums.

**Training and Retrainig:** Less than 25% claimed to usually organize sound training for their new staff. Re training is not popular among practicing Estate Surveyors and Valuers. This no doubt makes the knowledge of the staff to be mundane and unaware of important changes and development in Real Estate Practice

**Attitude to work/ Team work:** over 55% of the staff of Real Estate firms are not happy with their work. They complained of low salary and stress. Their attitude to work is not encouraging as they work because they must work. The resultant effects are low productivity, poor initiative and absence of effective team work.

## **BOOSTING CAPACITY BUILDING AMONG ESTATE SURVEYORS AND VALUERS IN NIGERIA**

To boost capacity building among Estate Surveyors and Valuers in Nigeria with view to readily place us in vintage position in megacity development, the following measures should be considered:

1. The Nigeria Institution of Estate surveyors and Valuers (NIESV) to set more effective standard that will regulate staff strength and efficiency, minimum wage for workers. Emphasizing training and re training.
2. Practicing Estate Surveyors and Valuers to orientate their workers. Need to acquire latest technology in Real Estate practice.
3. Entrepreneurship aspect of our profession must be boosted if we are to remain much relevant in the business world
4. Re accreditation of Estate Surveying and Valuation firms should be a policy of NIESV to ensuring standard is kept.

## **CONCLUSION**

This work has established the challenges of the megacity, traditional roles of Estate Surveyors and Valuers, infrastructural needs of the megacity and Estate Surveyors' role. It is clear from this work that capacity building is a must if Estate Surveyors and Valuers are to remain relevant in mega city development.

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# ENSURING THE HEALTH AND SAFETY OF GHANAIAAN CONSTRUCTION WORKERS BY DECENTRALISED GOVERNMENT AGENCIES: AN EXPLORATORY STUDY

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Operations in the construction industry are associated with high levels of occupational hazard which often results in ill health, injuries and sometimes death. Generally, safety on construction sites is viewed as the responsibility of the contractor and the employee. However, to achieve a zero tolerance level a three-prong action, which includes government agencies established by law to enforce Occupational Health and Safety (OHS) at workplaces is absolutely important. This study investigated the roles of these agencies in ensuring safety on construction sites in Ghana. The study is an exploratory one. It included interviews with contractors and their employees and officers of the Labour Department and Department of Factory Inspectorate. The results indicated that these decentralized government agencies did not exhibit high levels of commitment to policing Occupational Health and Safety laws on construction sites partly because they are poorly resourced and lack the capacity to effective. It is suggested that in addition to resourcing these agencies, government must show commitment to job safety and health protection of workers by developing a national policy on OHS using the DFI as the focal point.

Keywords: construction workers, decentralised agencies, Ghana, Occupational Health and Safety.

## INTRODUCTION

It has become a cliché, but it is nevertheless true, that the construction industry has gained the notoriety as one of the most dangerous work sectors in many parts of the world (Gambatese et al, 2008; Carter and Smith 2006; Lingard & Rowlinson 2005). Indeed, the physical nature of the construction process, the attitudes of the employees, the culture of the industry, the uncertain production environment and a myriad of other factors make the industry unique and presents a number safety challenges (Loosemore et al., 2003, Petrovic-Lazarevic and Djordevic, 2002). In the European Union (EU), the fatal accident rate is about 13 workers per 100,000 in comparison with 5 per 100,000 for the all sector average and even though the accident rates have been on the decline since 1994, they are still high (Aulin and Capone, 2010).

About a decade ago, the rate of compensated injuries and disease reported in the construction industry in Australia was 37.4 per 1,000 workers, which was 63% higher

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than the all-industry average of 22.9 (Loosemore et al., 2003). Safety statistics for construction in the United States indicated that a total of 1,234 workers were killed on the job in the private construction industry in 2004 representing a 9-percent increase from the 1,131 fatalities reported in 2003. This represents a fatality rate of 12.0 fatalities per 100,000 workers in the private construction industry, fourth highest among industry sectors (Meyer and Pegula, 2006).

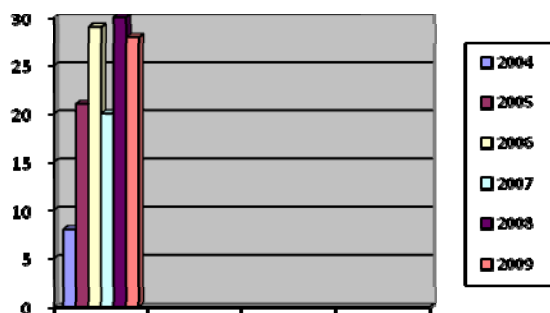
It is estimated that 7 - 10% of the global workforce works in the construction industry, but the sector accounts for at least 60,000 fatal accidents or 30 – 40% of all fatal accidents (Murie 2007; ILO 2005 cited in Lew and Lentz, 2010).

In many developing countries, accurate statistics of injuries and fatalities in the construction industry are hard to come by because many of these accidents go unreported. Nevertheless, the available statistics in some of these countries underscore the statement that the construction industry is fraught with hazard and risk. For example, in Ghana construction industry accidents continue to rise as illustrated in Table1. In 2004 the number of accidents reported was 8 and this rose to 28 in 2009 (250%).

Table1: Recorded construction accidents 2004-2009

Year	Number of accidents	Index
2004	8	100
2005	21	262.5
2006	29	362.5
2007	20	250
2008	30	375
2009	28	350

**Source:** National Labour Department, 2010



**Figure 1: Trend of construction industry accidents**

To ensure workplace health and safety governments in many parts of the world have passed laws and regulations to promote and enforce occupational health and safety (OHS) of workers at workplaces. Furthermore, agencies or boards are established to police these laws and assist employers in their efforts to ensure safe and healthful working conditions by providing information, education, and training in the field of occupational safety and health.

## **OCCUPATIONAL HEALTH AND SAFETY INTERNATIONALLY**

Generally, employers within the EU are bounded by the Council Directive 89/391/EEC which provides measures to encourage improvements in the Safety and Health of workers (Aulin and Capone, 2010). It also contains broad principles about the prevention and elimination of occupational hazards and information regarding training of workers. Furthermore, in recognition of the hazardous nature of the construction industry, the EU in 1992 published a special directive changing the way health and safety were being handled (Alves Dias, 2004 cited by Aulin and Capone 2010). The Construction Site Directive, CSD 92/57/EEC requires the construction industry to make efforts towards a continuous and sustained reduction of occupational accidents and diseases. The CSD 92/57/EEC is to guarantee the health and safety of workers on construction sites in the European Community whenever building or civil engineering works were carried out (Aulin and Capone, 2010). An important feature of the CSD 92/57/EEC is the introduction of a new concept of health and safety coordinating based on shared responsibility which includes owners and designers (Hughes and Ferret, 2007). It provides an important paradigm shift and challenges the traditional concept of placing the responsibility of health and safety solely on contractors and workers. The CSD 92/57/EEC has introduced new stakeholders in the health and safety of workers (Hughes and Ferret 2007; Usmen et al. 2001).

In the UK, the Health and Safety legislation is enforced by the Health and Safety Executive (HSE) and local authorities (the local council) under the Health and Safety at Work etc., Act 1974. Besides, many regulations specific to the construction industry have been enacted to deal with the peculiar nature of the industry. These include Health Protection Regulations 1992, Health, Safety and Welfare Regulations 1994. These regulations provide an enforceable set of measures aimed at ensuring that construction workers are not hurt in the course of their employment (Loosemore et al., 2003).

The Occupational Safety and Health Act of 1970 of the USA aims to ensure that, where possible, every worker works in safe and healthy working conditions. The law is administered by Occupational Safety and Health Administration (OSHA) of the US Department of Labour. The OSHA is authorised to conduct workplace inspections, with a few exceptions, without advance notice. If an employer refuses to admit an OSHA compliance officer, or if an employer interferes with the inspection, the Act permits appropriate legal action (Erven and Barret, 2010).

Workers in Canada are covered by provincial or federal labour codes depending on the sector in which they work. Workers covered by federal legislation (including those in mining, transportation, and federal employment) are covered by the Canada Labour Code; all other workers are covered by the health and safety legislation of the province they work in. The Canadian Centre for Occupational Health and Safety (CCOHS), an agency of the Government of Canada, was created in 1978 by an Act of Parliament. CCOHS is mandated to promote safe and healthy workplaces to help prevent work-related injuries and illnesses (CCOHS)

In Malaysia, the main legislation that governs safety and health of workers in both private and public sector are Occupational Safety and Health Act 1994 (OSHA94) and Factories and Machinery Act 1967 (FMA67). Both of these Acts are regulated and enforced by Department of Occupational Safety and Health (DOSH) (Bakri et al., 2010). Furthermore, to increase safety consciousness within the construction industry, the Construction Industry Development Board (CIDB) which is the regulating body

for the construction industry in Malaysia in collaboration with the National Institute of Occupational Safety and Health (NIOSH) has instituted a programme to conduct Safety and Health Induction for Construction Workers (SICW) or better known as Green Card Program. This a safety and health training programme is aimed at all construction workers and involves the registration and accreditation of construction workers (Bakri et al., 2010).

## **OCCUPATIONAL HEALTH AND SAFETY IN GHANA**

There is no occupational health and safety policy in Ghana (Adei and Kunfaa, 2007). The Factory, Offices and Shops Act (FOSA), 1970, Act 328, Workmen's Compensation 1987, Act 187 and the Labour Act, 2003 Act 651 are the main legislative instruments enacted by the government of Ghana to impose health and safety standards in the workplace (Adei and Kunfaa, 2007). The Labour Act, 2003, Act 651, for example contains a short provision, on occupational health and safety. It states unambiguously that it is obligatory for the employer to "ensure that every worker employed by him or her works under satisfactory, safe and healthy conditions (Labour Act, 2003 Act 651, Article 118:1) and for the employee to "use the safety appliances, fire-fighting equipment and personal protective equipment provided by the employer in compliance with the employer's instructions (Labour Act, 2003 Act 651, Article 118:3). Even though these legal provisions exist, work related accidents, injuries, and diseases continue to cost Ghana about 7 per cent of GDP (Ghana News Agency, 2003 cited by (Adei and Kunfaa, 2007).

The Factories, Offices and Shops Act (FOSA), 1970 Act 328 makes a specific provision for "Building operations and works of engineering construction" (Section 57). It gives authority to the responsible Minister, if he or she deems it appropriate, to make regulations adapting specific provisions of the Act in their application to building operations and engineering construction and concerning standards of scaffolding, ergonomics, timbering of excavations, site supervision and health and safety of construction workers.

The occupational health and safety (OHS) of persons employed in work places in Ghana (with the exception of agriculture, rail and road transport) are regulated by the Department of Factories Inspectorate (DFI) of the Ministry of Employment and Social Welfare (Bruce, 2010). The Inspectorate, which should have subsidiaries at the Districts, is responsible for the promotion and enforcement of regulatory measures to give effect to the provisions of the Factories Offices and Shops Act.

## **THE ROLE OF OCCUPATIONAL HEALTH AND SAFETY AGENCIES**

The role of OHS agencies cannot be over emphasised. The literature has established that most countries have legal provision or policy that comprehensively addresses occupational health and safety but to give effect to these legislations surveillance mechanisms or agencies for enforcing OHS legislations have been put in place. For example, in the US the Occupational Health and Safety Administration (OHSA) monitors OHS practices in work places while in the UK it is the responsibility of the Health and Safety Executive (HSE) (Loosemore, et al.). However, in Ghana the DFI, which is the enforcement agency of FOSA, is handicapped with systemic challenges which disable it from effectively carrying out its mandate. Dei and Kunfa (2007) reported that DFI could only do restrictive inspections, education, and enforcement because it is under resourced.

## RESEARCH OBJECTIVES

The objectives of this exploratory study are:

1. To determine whether Departments of Factories Inspectorate as prescribed by the Factories, Offices and Shops Act 1970, Act 328 exist at the district levels;
2. To determine whether they are performing their statutory duties in accordance with the Act; and
3. To determine any challenges being faced by these agencies in delivering occupational health and safety practices at the local levels.

## RESEARCH METHOD

In order to get the relevant formation for this exploratory the research, literature on the subject was reviewed which was followed by interviews to collect data from the decentralised agencies. Non-probalistic convenience and quota sampling techniques were used in the selection of respondents. The respondents included the following:

- Four (4) contractors, one each from four regional capitals; Accra, Sunyani, Cape Coast, and Kumasi.
- Twelve (12) construction employees three (3) from each of the four construction companies listed above;
- Three officers of the Department Factories Inspectorate (DFI) one each at Accra (Metropolitan Assembly), Sunyani (Municipal Assembly), Kumasi (Metropolitan Assembly) (there is no DFI in Cape Coast)
- Three officers from two District Assemblies (Sunyani West and Ajumako-Enyan)

## RESULTS

### Interview with contractors

#### *Characteristics of the construction companies*

One of the four construction companies selected had been in existence for more than 10 years; two were between 6 and 10 years and one between 1 to 5 years. At time of the interview all the four contractors had at least one on-going project which was not more than two years old. The representatives of the four companies interviewed were Site Foreman (1), Site Engineer (1), Quantity Surveyor (1) and Supervisor (1). They were resident on site constantly.

Table 2: Age distribution of companies

Age of company	Number of companies
1 -5	1
6 - 10	2
Above 10	1

*Visit to site by personnel from the local Department of Factory Inspectorate or any other OHS related agency.*

All the respondents reported that building inspectors, officers from the Department of Factory Inspectorate (DFI), and personnel from the Environmental Protection (EPA) had ever visited their construction sites. The interview further revealed that: building inspectors only inspect records and documents to ensure that the required permits are

obtained and that the building plans are in conformity with National Building Regulations; the main focus of officers from DFI is compliance which safety requirements. They do not audit OHS records or assess any health and safety management system designed by the contractor to ensure safety on the site and neither do they demand that the contractors send any of such records to the inspectorate for examination; and officials from EPA are more interested in the effect of the construction operation on the environment.

It could be inferred that the DFI may not be complying fully with the requirements of the Factories Offices and Shops Act, 1970 Act 328 which enjoins an inspector to examine documents of the contractor relating to issues such as accidents and diseases occurring on the site (Section 6).

*Visit by personnel from the Department of Factory Inspectorate (Local) or any other OHS related agency to a current project site.*

The four companies interviewed were constructing building projects that were at various stages of completion; between one and two years after commencement of construction. In relation to the on-going project, the respondents reported that the project site had been visited by building inspectors from the assemblies, personnel from the National Road Safety Commission and the EPA but none from the Department Factory Inspectorate. All the contractors (4) said their sites had never been visited by any officer from DFI; one contractor said his site had been visited by an officer from the Labour Department between 3 and 4 times. Two respondents said building inspectors from the assemblies had visited their sites once or twice; another two said building inspectors had been on their site 3 or 4 times. Regarding inspections by EPA, one contractor confirmed that his had been visited once or twice while another one said his site had been visited 3 or 4 times (Table 3).

Table 3: Frequency of site visits by Departments responsible for OHS within 1-2 years

Organization	Number of visits to the site				
	Never	1-2	3-4	5-6	7 and above
Department of Factory Inspectorate	4				
Labour Department			1		
Building Inspectors from Assemblies		2	2		
Environmental Protection Agency		1	1		

The inability of the DFI to visit the respondents' current construction sites corroborates the assertion by Dei and Kunfa (2007) that DFI is under resourced and therefore could only do restrictive inspections, education and enforcement.

#### *Enforcement of health and safety regulations on site*

The respondents agreed that even though their sites had never complied fully with the rules and regulations required by the legislations, they have never been penalised by any of the health and safety enforcement agencies for violating the law. They also said they had never heard that penalties had ever been imposed on any contractor for non-compliance with Health and Safety Regulations. This gives the impression of OHS agencies' lack of commitment towards construction workers' health and safety. This is manifested by the unsafe environment in which construction workers continue to work in Ghana. Dei and Kunfa (2007) also suggested that the unsafe working environment

in wood processing industries in Kumasi and the workers vulnerability to occupational hazards and accidents could be attributed to lack of commitment of government to workers health and safety among other reasons.

### **Interview with workers**

#### *Characteristic of workers*

A total of twelve male employees were interviewed, three from each firm. They were all full-time tradesmen in their companies. Five of the respondents had been employed for seven years, three for six years and the rest for four years.

Table 4: Number years in company

<b>Years in company</b>	<b>Number of employees</b>
4	4
6	3
7	5

#### *Interaction of employees with health and safety enforcement agencies*

Ten workers confirmed that within the period of their employment they had at least once seen a health and safety inspector on their sites whilst two (2) said they had never seen any. An answer to a follow-up question revealed that no personnel from the Department of Health and Safety Inspectorate had ever visited their current sites. This is consistent with what the contractors said. These workers confirmed visits by building inspectors and personnel from Environmental Protection Agency.

As earlier indicated, construction is inherently dangerous and it is one of the most dangerous working sectors high accident rates (Carter and Smith 2006). It seems that despite an increased awareness and the recognition of the dangers posed to health and safety by construction activities (Loosemore, et al.) the DFI does not consider the construction industry a priority which demands its urgent attention. On the other hand, it could be argued that the infrequent or lack of visit by the OHS regulatory agencies to construction sites is due largely to lack of human and material resources or the absence of a government policy on health and safety of workers in Ghana (Bruce, 2010)

### **Interview with decentralized agencies**

#### *Building inspectorate divisions of metropolitan, municipal and district assemblies*

The interviews reveal that the Building Inspectorate Divisions of the six local governments visited are only responsible for the physical development and not necessarily the health and safety of the workers. The respondents said their role is to ensure that developers adhere to building regulations and that the buildings are construction on sites zoned for that purpose. It is also their responsibility to ensure that all required notices are given by the developers and all the approval processes have been followed.

Out of the six people interviewed three had Higher National Diploma (HND), the highest educational qualification attained. Two were technicians and one did not tell his qualification but said “he rose through the ranks.” It obvious that the decentralised agencies lack the right number and quality of staff to be able them execute their mandate satisfactorily.

### *Labour Departments*

Heads of four labour departments were interviewed concerning the departments' statutory responsibility. Three revealed that the Department's sole responsibility is to ensure workers' welfare, assess the extent of workers' injuries if an accident occurs and assist them in obtaining compensations from their employers. According to these interviewees, it is the responsibility of the DFI to ensure safety compliance and enforcement of the law. On the other hand, one of the respondents, referring to the Labour Act, 2003 (Act 651), said the Department is also mandated to enforce the compliance of health and safety regulations at the workplace. This is an evidence of role ambiguity among employees of the Labour Department.

The diversity of agencies involved in OHS of workers shows the importance of OHS issues to the government. However, according to Bruce (2010), the fragmentation of OHS implementing agencies may divert from the main focus and direction necessary for effective prevention of occupation accidents and work related diseases. He suggested the DFI to be the national agency responsible for OHS of workers because of its recognized role by the International Labour Organization (ILO) as the focal institution (Bruce, 2010).

### *Factory Inspectorate Department*

Three Departments of Factory Inspectorate in Accra, Kumasi and Sunyani were visited and the heads of these Departments were interviewed.

The respondents were unanimous that the inspectorate is responsible for the promotion and enforcement of regulatory measures stipulated by the Factories, Offices and Shops Act 1970, ACT 328. However, the survey revealed that the Department lacks the human and material resources necessary to carry out their work and therefore was selective in where they inspected. This is in agreement with Adei and Kunfa (2007) who also observed in their study of OHS policy in the operations of wood processing industry in Kumasi, Ghana that logistical, financial and staffing problems have made the enforcement of FOSA ineffective.

The interview also revealed that the main focus of inspections concerns compliance with safety requirements. Site documentations are not inspected or audited to determine the safety management processes of the employers. It was also revealed that there is no relationship between the DFI and the Labour Department each has its hierarchical structure.

## **CONCLUSION**

Traditionally, occupational safety and health were viewed as the responsibility of the contractor and the employee (Lew and Lentz, 2010). However, to achieve zero injuries on construction sites, it must be tripartite action involving government agencies established by law to ensure the promotion and enforcement of OHS regulations. The study was undertaken to determine whether OHS agencies were at the local level, the extent to which these decentralized agencies of government were involved in ensuring safety on construction sites and the challenges faced in the discharge of their duties. It was observed that OHS agencies were not at all local levels (districts). The agencies studied did not exhibit a high sense of commitment to



policing the OHS laws resulting in infrequent inspections or selective inspections of construction sites. This has been attributed in part to lack of human and material resources and failure of government to have a national policy on Occupational Health and Safety.

## **RECOMMENDATIONS**

- To ensure zero level of avoidable accidents in the construction industry, there is the need to emphasise the tripartite role of employers, workers and government as the basis for any effective OHS programme.
- Government should adequately resource all enforcement agencies of OHS legislation to enable them effectively discharge their responsibilities. In addition, the pay and other benefits of inspectors must be enhanced to attract the right calibre of staff and reduce the high rate of attrition that currently exists.
- An intuitional facility must be identified for training of OHS professionals at the local levels to improve their competence and increase their self-confidence.
- It is important for government to have a national policy on OHS using the DFI as the focal point to avoid the fragmentation of implementation agencies which usually results in duplication of efforts and waste of scarce resources.

## **LIMITATIONS**

This study is an exploratory one and a precursor to a wider study. The results relate to the specific districts studied

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# ENVIRONMENTALLY RESPONSIBLE INTERIOR DESIGN (ERID) SOLUTIONS FOR AIR-CONDITIONED OFFICE SPACE IN DUBAI

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The building industry continues to see a growing interest in creating solutions that consider the priorities of indoor environmental quality, energy conservation, and design that tread lightly on the planet (eco-pluralistic design approach). Several studies have shown that there is an obvious link between indoor climate and health, comfort, and productivity. Thus, it is possible that an investment for a better indoor environmental quality could be profitable with at least very modest productivity improvements. This study examines indoor environmental conditions of air conditioned office space in Dubai. The study was conducted by distributing questionnaires to the office occupants to get their perception of the indoor environmental conditions. Expert walkthrough was also conducted. Integration among the structural, envelope, mechanical and interior systems and their contribution towards Environmentally responsible interior design (ERID) were taken into consideration during the expert walkthrough. Findings from the methods adopted indicate that the office indoor environment is unhealthy and not environmentally responsible. ERID solutions were proposed to address problems observed (during walkthrough) and reported by the office occupants. This study is significant because it addresses issues relevant to building occupants health and comfort, and building sustainability.

Keywords: environmentally responsible interior design, indoor environmental quality, energy conservation, air conditioned office space, Dubai

## INTRODUCTION

Human resource is an essential capital to the economy of a country. Majority of these activities done by human beings take place mostly in indoor environment, specifically in office space. The adverse effects of poor indoor environmental quality 'IEQ' comforts (indoor air quality, thermal, acoustic, visual/light, special, building integrity) has recently become an issue of active scientific investigation because of its potential health and perceptual implications with consequent increase in sick building syndrome (SBS) intensities, deterioration in work performance. These effects are translatable to substantial economic loss, commensurate with the scale of a country's knowledge-based economic activity performed in the indoor environment (Fisk, 2000; 2002; Wargocki, 2002; Olsen, 2005). This means these office spaces must be given due and consistent attention.

Addressing this issue is of particular concern in Dubai which has seen great and fast development in recent years. Due to this development, Dubai is attracting people from all over the world. Consequence of this increase will be increasing number of motor

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vehicles, especially in Dubai where luxury and driving car are norm. Motor vehicles for example, release many harmful gases to the environment. The gasses include primary pollutants (nitrogen oxides, hydrocarbons, carbon dioxide, benzene, carbon monoxide, sulphur dioxide, carbon particles, fine particulate matters) and secondary pollutants e.g. ozone (forms when hydrocarbons combine with nitrogen oxides and chemically react in sunlight), peroxyacetyl nitrate (PAN), etc. These gases can find their way into the building via ventilation system, especially if adequate filters are not used. Coupled with numerous indoor sources of pollutants, office occupants can be exposed to poor indoor air quality (IAQ) on a daily basis. Particulate matters generated from construction activities and dust hazes are also serious IAQ concern in Dubai. All these activities can also generate significant acoustical discomfort if appropriate measures are not taken. Geographical location of Dubai in the tropics (closer to the equator) also means visual/light (e.g. glare) and thermal comforts are issues to be taken into consideration especially with the pertinent issue of conserving energy and reducing or eradication of reliance on non-renewable source of energy. Furthermore, spatial comfort (adjacencies, accessibility, way-finding, efficiency, ergonomics, etc) and building integrity (e.g. degradation, fire safety, etc) are issues that cannot be left out in order to achieve ERID for office occupants.

## **OBJECTIVE OF THE STUDY**

This paper presents pilot study conducted in an air conditioned office space in Dubai, United Arab Emirate. This study was embarked on with the purpose of getting a pre-understanding IEQ condition of office environment in UAE. It also aims to proffer environmental responsible solutions to address identified problems. It is envisaged that the study will lead to more comprehensive study that will aim to understand IEQ condition in several air-conditioned office buildings in the UAE.

## **LITERATURE REVIEW**

Bako-Biro et al. (2004) conducted study to determine the effect of pollution from personal computers on perceived air quality, SBS symptoms and productivity among 30 female subjects in low polluting office. The experiment was done by have different scenarios of exposure (presence or absence) to 3-months-old personal computers at constant outdoor air supply of 10l/s per person. When the PCs were present they were not visible (behind a screen) to the subject. It was observed that presence of PCs significantly (dissatisfaction of the perceived air quality (PAQ) ranges between 13 to 41% and time for processing of text was increased by 9%) affect the PAQ in the office. In a study done by Lee et al. (2001) in an environmental chamber simulating an office environment to characterize volatile organic compounds (VOCs), ozone and particulate matters (PM) emissions, it was observed that significant amount of VOCs, ozone and PM were generated from laser printers, two ink-jet printers and one all-in-office machine. It was noted that emissions of ozone and VOC from laser printer were significantly higher than that from ink-jet printers. The highest emission rates of VOCs compounds were found to be toluene, ethylbenzene, *m*, *p*-xylene, and styrene.

A study on symptoms prevalence among office employees and association to building characteristic by Skyberg et al. (2003) reveals that female office workers complain more about indoor-air-related symptoms than their male counterparts. Allergy, passive smoking, VDU work and psychosocial load were reported to be strong predictors of the symptoms while allergy was observed to be the strongest predictor of mucosal symptoms. Absence of local temperature control was also found to increase the risk of mucosal symptoms. Seppnen et al (2004) observed in their study on 'ventilation and

performance in office work' that office worker performance increase significantly (statistically) with increased ventilation. A study on PAQ, SBS symptoms and productivity in an office with two different pollutant loads done by Warkgocki et al. (1999) reveals that presence of pollution load (20-year-old used carpet introduced on a rack behind a screen, thus invisible to the occupants) resulted into increased SBS symptoms (Air stuffiness, increased dryness of air, airways and eyes, illumination, headache, difficulty in thinking clearly, and fatigue) and decreased in productivity (speed of text typing, addition, logical reasoning, serial addition). Jamriska et al. (2000) show that vehicle combustion aerosols is the main pollutant of indoor airborne particles. They found the characteristics of particles indoor to be largely similar to that of vehicle combustion aerosols. Buchanan et al. (2008) observed that oxidation products resulting from filter surface chemical reaction (due to deposited outdoor ozone on used filter) may explain building related symptoms reported by workers in 34 office buildings. Witterseh et al. (2004) did a study on the effects of moderate heat stress and open-plan office noise distraction on SBS symptoms and on the performance of office work using three air temperatures (22/36/30°C) and two acoustic conditions- quiet (35dBA) or open-plan office (55dBA). This was done using thirty (16 male and 14 female) subjects aged 18-29 years, clothed for thermal neutrality at 22°C, performed simulated office work for 3h under all six conditions. They observed the following: increase in temperature decreased thermal acceptability and PAQ; increased temperature increases SBS symptoms (eye, nose and throat irritation, headache intensity, difficulty in thinking clearly and concentrating) complaints, and decreased self estimated performance; noise increased fatigue and difficulty in concentrating. According to Clements-Croome and Baizhan (2000), indoor environmental stress (which may be due to poor IAQ, thermal, acoustic, visual, and spatial arrangement, etc) can also affect productivity in an office environment.

## METHODS

### The Building

The office space (see Figure 1) used for this study is in a building located in Dubai, southern side of Sheikh Zayed Road- a very popular road in Dubai (Latitude 25.13°N Longitude 55.23°E). The building is subjected to an annual average maximum temperature ranges between 23.9°C – 41.3°C, and an annual average minimum temperature ranges between 14.3°C – 30.3 °C. The average annual sunshine hours/day ranges from 8 up to 12 hours. The site analysis done reflects the impact of the location on the building. The building was built in 1998 (pre-energy conservation) with structural and architectural systems. The structural system can be described as modern-industrial metal structure. The main façade is fully glass – 48m long by 10m height– supported by linear metal construction and located in the west with horizontal shading extended into 2m. The walls are constructed with concrete, while the ceiling is made of aluminium panels. The measured office space is on the first floor of the building and has a door leading to factory (used by the measured interior design office space for making their wood products). The factory space is of double volume and has small office component which is connected to the main office (measured space) by steel bridge. Activities in the factory (at the ground floor) can easily be seen from this steel bridge. There is access (via steel spiral stair case) from the small office component (of the factory) to the factory ground floor.

## Study Protocol

**Walkthrough and interview:** Expert walkthrough investigation was conducted using five (5) sense organs (eye, ear, nose, tongue, and hand) as measuring instruments. Information from the walkthrough will be useful when analysing feedback (via questionnaire) from building occupants and to understand (from investigator perspective) problems that needs to be addressed. Interview was also conducted with the building maintenance supervisor as access to the Air Handling Unit (AHU) room was not granted.

**Questionnaire:** Questionnaire was distributed to the building occupants to understand office occupants' perception of the office space's IEQ conditions and the IEQ impact on their health and comfort. Specifically, occupants were asked to evaluate health impact (due to indoor air quality exposure), thermal comfort, acoustical comfort, light and visual comforts, spatial comfort and building integrity. Apart from the IAQ section which was rated as 'Yes/No', the other environmental factors were rated as 'Poor/Average/Excellent'. The questionnaire was filled by 61% of the total occupants (22 out of 36). The breakdown down shown in Table 1 and office space layout and allocation shown in Figure 1 will help understand the needs of the occupants and the effect of these needs on questionnaire feedbacks.

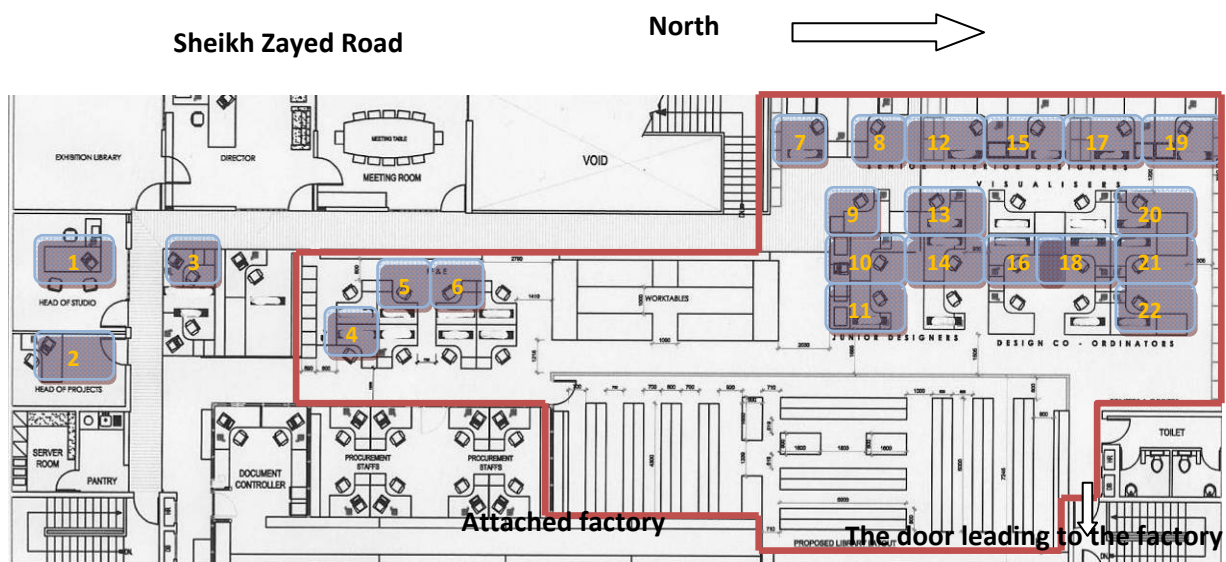


Figure 1: Office space layout and allocation. (1) Head of studio 'HOS'; (2) Studio Design Manager; (3) Personal Assistant to HOS; (4), (5) and (10) Specification Organiser- FF& E; (6) Senior Project Manager (ex-occupant); (7), (12) and (15) - Senior Interior Designer; (8), (9) and (11)- Interior Designer; (13) and (20)- Visualizer; (14)- Drawing controller; (16), (18), (21), (22)- Designer Coordinator; (17)- Senior Project Manager, (19)- Studio Support Manager.

## RESULTS AND DISCUSSION

### Expert walkthrough and interview

The office space was found to be very noisy especially during lunch time. As no lunch area is provided for the staff, so they have their lunch on their workstations individually or in groups. There is no speech privacy due to acoustic level of the office, considering the open office plan. During the investigation, offensive and

irritating smell were perceived throughout the office. Interestingly, several occupants were found coughing and/or sneezing most of the time during the investigation. These impacts are reflections of the hazard posed by the high concentration of pollutants in the indoor air, emphasised by the HVAC system that does not ventilate the air properly and do re-circulate these pollutants (including dust from the factory) accumulatively into the indoor air daily. Poor materials' maintenance in the overall space was revealed during the investigation, reflected in different observations, such as: settled dust on indoor surfaces, carpets, skirts, window seals, library items (fabric, hard finishes, catalogues binders, etc); leaking ceiling panels- it was reported that during raining season, some of the computers under the leaking ceiling panels were replaced; very smooth wooden staircase - there were reported cases of people tripping down the stairs.

Table 1 Percentage of occupants' designations : 22 (number of occupants that took questionnaire)

No. of occupants	Designation	% per Occupants' Designations
1	Head of Studio	5
1	Studio Design Manager	5
1	Personal Assistant for HOS	5
3	Senior Interior Designer	13
3	Interior Designer	13
2	Senior Project Manager	9
3	Specification Organizer – FF&E	13
1	Studio Support Manager	5
2	Visualizer	9
1	Drawings Controller	5
4	Design Coordinator	18
22	Total	100%

Different personal behaviour actions were observed during the investigation, reflecting harmful and un-professional solutions for serious issues, such as air freshener located very close to photocopier machine with the intention of purifying smell from the photocopier machine. However, this is a potential source for formation of secondary organic aerosols and other oxidation products (e.g. Formaldehyde, acetone, etc) generated via ozone (generated from photocopier machine) and unsaturated hydrocarbon (e.g. limonene emitted from air freshener) chemical reaction. This process is called indoor chemistry. The lack of essential knowledge of IAQ among the office occupants can cause serious health implications. Movement of dust and volatile organic compounds (VOCs) from the factory to the measured space (via connecting door- see Figure 1) were perceived. This happens often as people in the measured office space need to go the small office component of the factory where specifications and details of wood to be used are usually initiated. Thus, the connecting door is not always closed. With this, the office occupants (in the measured space) will usually be exposed to significant amount of dust and VOCs.

Several building occupants were seen wearing jacket due to very cold indoor environment. This reflects the lack of personal control over the supplied air temperature and the un-proper settings of the system during the duty working hours –

occupation time of the building. Several building occupants were found to be using pillow on their chair to support their back, in a try for better adjustment for the furniture seeking relaxation and healthier position. Naked wiring systems were found on the floor. Some of the telephone lines/networks were disconnected during the investigation when building occupants were moving over these wires, reflecting lack of maintenance for an old communication system that might need to be changed and poses safety hazard to occupants. Printers and scanners are scattered around workstations, making the occupants at the risk of inhaling pollutants from these equipments, in addition to acoustic disturbance. Poor penetration of natural light to workstation in the in-depth of the building was observed, because of storage units that are allocated in a way that blocks the daylight. Poor lighting distribution and illumination were observed. Some luminaires in the library for example are located above the storage units instead of working space. This illustrates the lack of integration between the lighting distribution and furniture layout, reflecting conflict between two building systems – mechanical and interior.

It was gathered from interview conducted with the building maintenance supervisor that the building was designed for another company with total different space planning and furniture from the current spatial design. That design was not maintained through the years. The structure, architecture and mechanical are the same since it was built. However, interior design has been changed without any study strategy. Several damaged materials were observed in the studio. According to the supervisor, maintenance schedule focuses mainly on machinery, and equipment e.g. photocopier machine, computers etc with little or no schedule for the facilities. It was gathered that the carpet has not being maintained for at least 6 years. The mechanical ventilation maintenance is done only on annual basis or during breakdown. It was gathered that the fresh air intake is totally shut off (i.e. office occupants are expose to 100% recirculated air). According to the building supervisor, there are reported cases when building occupants complain of bad smell. It was gather this usually occurs when dust or some gases are emitted from the ventilation system into the studio. This is an indication that components of the ventilation systems are dirty and/or not working as they should.

### **Questionnaire**

Figure 2 shows the percentage (%) of reported health symptoms by building occupants. Significant numbers of the office occupants complain of cough; headache; nose, throat and respiratory irritation. According to (Wolkoff et al., 2006), exposure to VOCs is the main culprits for these symptoms. The likely sources of VOC are old carpets and office equipments. Others include dirt/dust from the library, factory, outdoor (via ventilation system). Glue gun, adhesive spray, air freshener and perfume observed in the office space also release VOCs (to the indoor environment) causing reported symptoms (shown in Figure 2) among the building occupants.

Environmentally responsible solutions are required (especially when there are more than 30% complains for almost all the highlighted health impacts) to address these problems that can cause reduction in office workers' performance and productive, and can also increase absenteeism due to sickness (Wargocki et al., 1999).



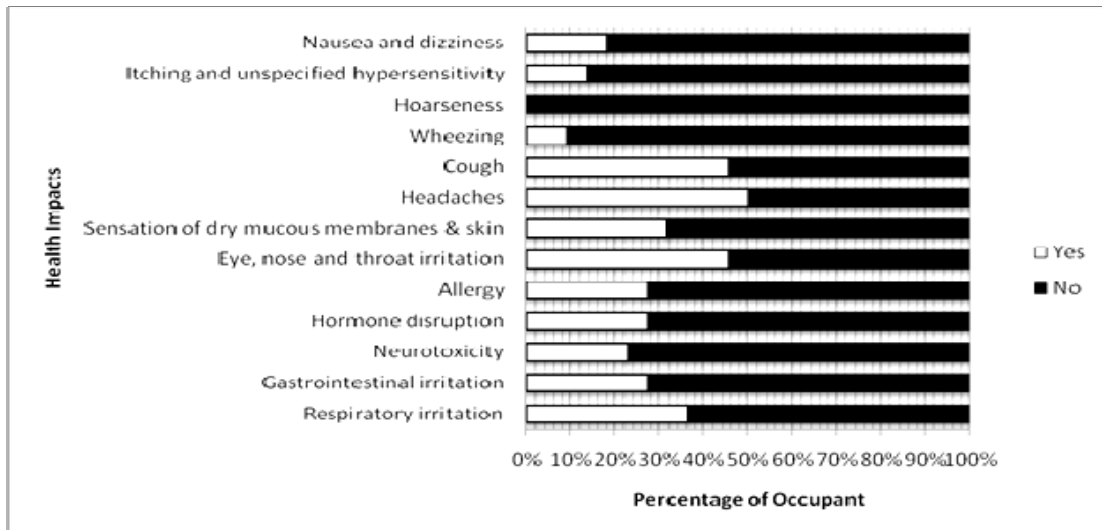


Figure 2: Occupants' feedback on health impacts due to the indoor air condition

As shown in Figure 3, majority of the office occupants either rate the acoustical conditions of the office to be average or poor. This finding does not come as a surprise as major sources of acoustical discomfort were observed during the expert walkthrough. Adequate solutions to reduce or eradicate this discomfort are essential. It is essential because acoustical discomfort does hinder work performance.

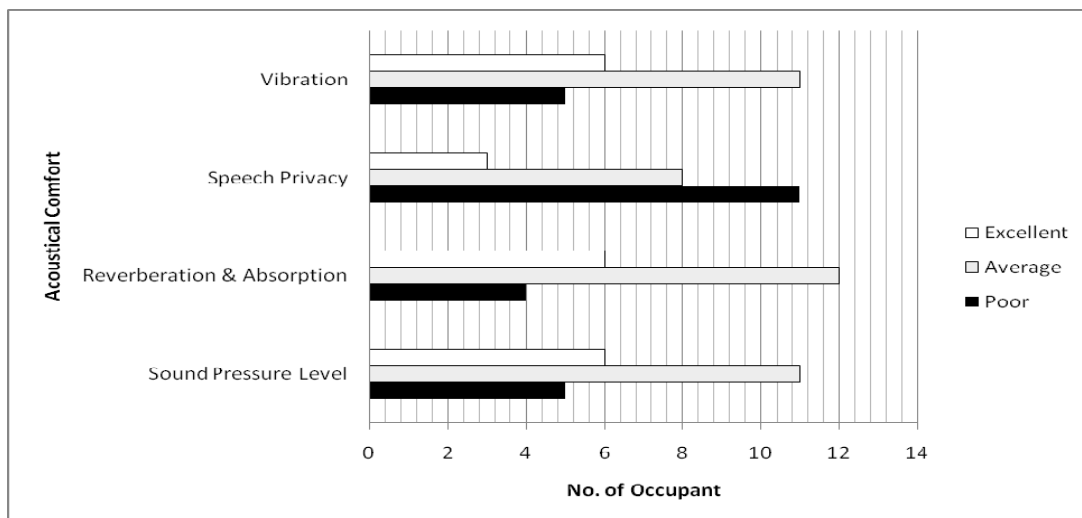


Figure 3: Occupants' feedback on perception of acoustical comfort

Thermal comfort rating in the office space as shown in Figure 4 reveals that most of the office occupants are dissatisfied with the office thermal conditions. The office space temperature is either too cold or too hot. According to the interview done with the building maintenance supervisor, there is no proper control for the mechanical ventilation system. When the office occupants complain of cold (usually around 8am to 12pm), the only option available to the maintenance supervisor is to turn off of the mechanical ventilation system (usually around 12pm to the end of work hours) making the office space to be hot. If adequate solutions are not proffered, performance of building occupants may decrease significantly. American Society of interior designer 'ASID' (2005) shows that increased acoustical level can significantly reduce office workers performance.

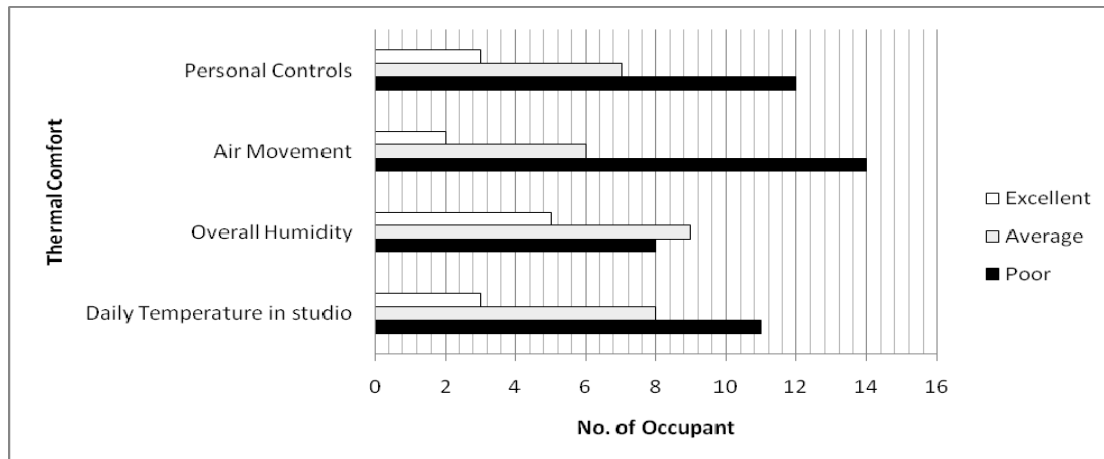


Figure 4: Occupants' feedback on perception of Thermal comfort

Significant numbers of the office occupants are also not satisfied with the office artificial and natural light conditions (see Figure 5). The readers should note that majority of the office occupants that rate the natural light to be excellent are seating closer to the window (facing Sheik Zayed road) as shown in Figure 1. The feedback correlates with the walkthrough investigation. There is need to allow more natural light into depth of the office space. This will require critical and creative thinking on how to integrate natural and artificial light. Making use of the available (in abundance) natural light will not only save energy but increase health and performance of the building occupants.



Figure 5: Occupants' feedback on perception of Light and visual comfort

Majority of the occupants feel office spatial arrangement is of average quality and with significant number saying it is of poor standard (see Figure 6). This current spatial status needs improvement. In addition to the fact that spatial discomfort causes stress on office occupants, it is also a concern from IAQ perspective e.g. dust on scattered office items (drawings, fabric samples, etc). One of the main responsibilities of interior designers is the health and safety of building occupants. If building integrity issues listed in Figure 7 are not taken serious, the health and safety will be in jeopardy. Same as spatial comfort, majority of the occupants feel office building integrity is of average quality and with significant number saying it is of poor standard. The dissatisfaction by the office occupants in terms of spatial and building

integrity comforts can be explained by discussion under the walkthrough investigation section.

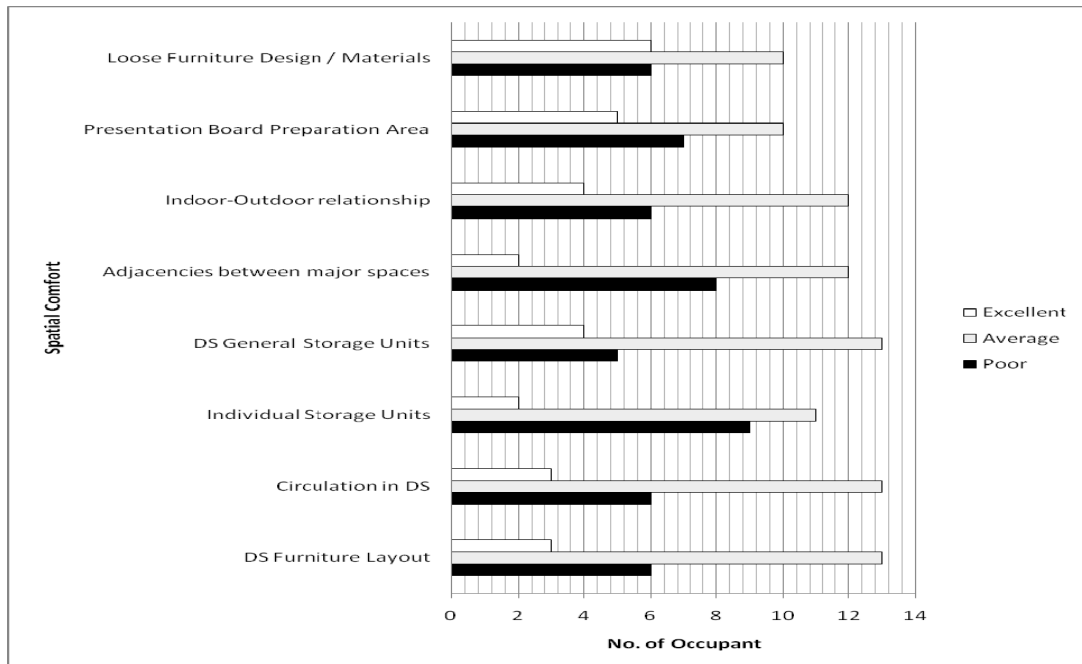


Figure 6: Occupants' feedback on perception of spatial comfort. DS= Design studio

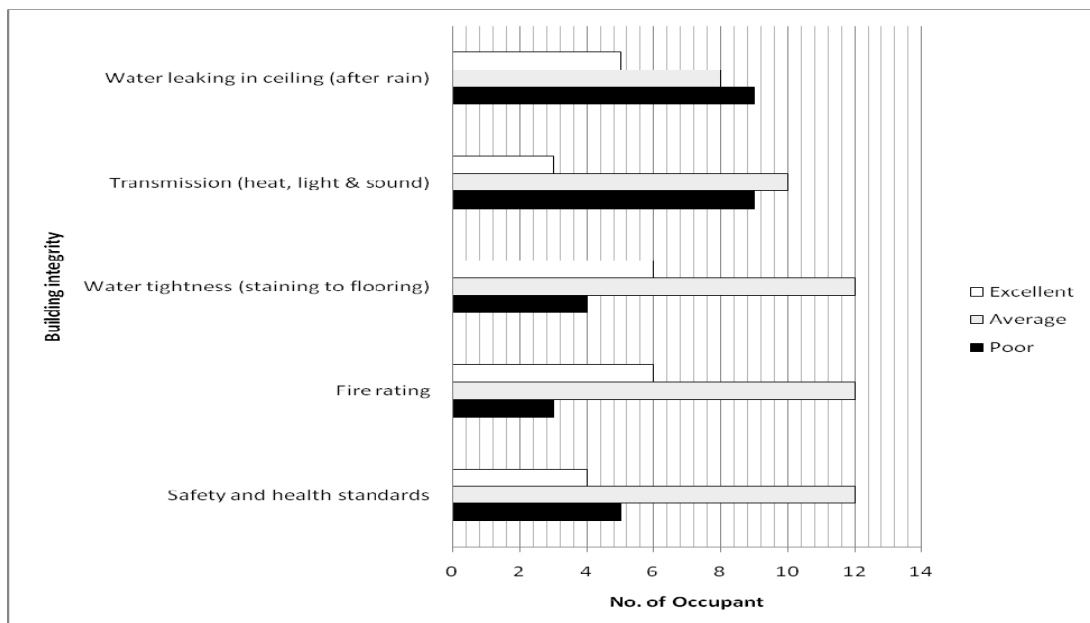


Figure 7: Occupants' feedback on perception of building integrity comfort

## RECOMMENDATION

In order to provide a healthier and more efficient environment for the occupants, sufficient environmental solutions should be addressed. The main issue that should be solved in this office is the HVAC system. A new system is recommended to be installed with certain specifications in the aim of improving the IAQ. The system should allow 10% of outdoor air and 90% of recirculated air; for the goal of renewing the circulated air and minimizing the circulated pollutants. Studies (Weschler, 2003; Fadeyi et al., 2009) have shown that increase in outdoor fresh air rate can help dilute pollutants on indoor sources. In addition, efficient filters should be adapted in the

system; one for the outdoor fresh air, and the other behind the mixing plenum for outdoor and recirculated air. According to Beko et al (2009), combination filters (filters integrating activated carbon into particle filter) should be used. This should reduce the amount of pollutants in the air, as well as improve the IAQ. The use of this kind of filter is of particular importance in this part of the world where outdoor ozone concentration and particle concentration tends to be very high, and numerous pollutants generated due to increasing number of vehicles. In addition to the benefit of significantly reducing sensory offending chemicals that offgas from loaded filters, the cost of maintenance will be lesser compare to conventional filters normally used in air handling units. Thus, it is environmentally responsible in terms of lesser resources needed for maintenance and ability to improve occupants' health. Maintenance should also be provided continuously to the overall component of the ventilation systems.

To improve IAQ, thermal, and light/visual comfort of the office space, personal environments system should be adopted. With this kind of system at every workstation, each occupant can have their own personal control system for a better environment (controlling the temperature, airflow direction, adjusting the task light as needed, etc), without disturbing the other people. In addition to improving occupants' health, comfort and perception of the environment, reduction in absenteeism, higher employee morale, significant amount of energy can be saved, thus reducing utility bills and saving the environment at the same time. For example, the temperature will not be set very low all the time, the amount of luminaires needed at the ceiling level will be reduced (especially with better integration with natural light and use of automation system to enhance the integration) and task light will only be switch on when needed. This personal environment system would need a raised floor construction in order to adapt the installation. This can easily be achieved with height of the office space being 4.2m. The more environmentally friendly and very well studied the solution is, the more advantages for other systems are achieved in the process. With the application of the raised floor for a better mechanical system, the naked wiring system problem can be solved at the same time, being maintained and placed properly. On the other hand changing the floor system will help in the process of getting rid of the old and non-maintained carpet, and propose a new finish which should be environmentally friendly and functional for the raised floor. For example, cork flooring materials which is biodegradable can be used. It has additional benefit of increasing thermal insulation, improving acoustical control through sound dampening.

Huge amount of pollutants sources in the space need to be addressed. Although a more efficient ventilation system (including use of good filter) can significantly reduce indoor pollutants concentration, eliminating sources of pollutants is the best strategy for improving IAQ. For example, the use of significant amount and strong perfume (one of the major sources of VOC in indoor environment - a common trend in UAE especially among ladies) should be significantly minimized if it cannot be totally eradicated realistically. Low or no VOC emitting cleaning detergent should be used in cleaning the office environment. Use of air freshener should be banned from the office, etc. Thus, education of the occupants on implication of their activities on IEQ in general is essential. Isolation and ventilation of lunch room for occupants to have their lunch without disturbing others working and in environmentally friendly manner is of paramount importance. Same applies with photocopy machines, printers and scanners, they should be separated from the office area and be located in a very well ventilated room (with exhaust fan) to get rid of most of the pollutants generated by these machineries. This isolation of scattered machineries will improve overall

outlook and perception of spatial arrangement by the occupants in addition to improving IAQ, thermal comfort, acoustical comfort and building integrity (improving fire safety). Proper storage of scattered documents, wood materials, fabrics, etc can also improve spatial and building integrity comfort in addition to improving IAQ (i.e. prevention of dust collection). This should also be followed with changing the type of adhesive that is used in the 'presentation preparation area' into low or no VOC emission adhesive. Water based adhesive using nontoxic compound and mechanical fixings can also be considered as alternatives. Direct access (door) from the adjacent factory to the office space should be sealed. Access to the factory should be from outside and not from the office space. Covered walk way can be made to make movement to the factory (from outside) more comfortable in case of rain or sunny days.

Regular use of sound system for music should be forbidden. It should be used only for announcements. Head/ear phones should be used by individual that wants to listen to sound. On the other hand, the sound insulation of the ceiling materials should be enhanced, after applying a proper and thorough maintenance for the material. One of the proper solutions would be applying environmental friendly sound insulation materials underneath the aluminium panels that are already there with a gap of air to enhance the insulation. The proposed material is stretch fabric material, which usually used for swimming pools and accredited from United Kingdom (UK) Green Building Council among other organizations. But it is believed that with the specifications (<http://www.stretchceilings.co.uk/technical.asp>) it has it will be a proper solution for the existing ceiling. This fabric has a variety of colour ranges and having it as suspended ceiling can give a great chance to transfer day-light through the gap into the middle area of the office providing proper reflecting material in the gap from the facade side moving toward the desired area, with a proper installation for a day-light diffuser to be installed. In addition this should be addressed with a revised lighting plan to solve the conflict between the furniture layout and the lighting plan. The furniture should also be rearranged to allow for light penetration. The uncomfortable seat currently available in the office should be replaced with eco-friendly seat. E.g. Herman Miller chair (but not limited to this example), which provides levels of comfort, performance and recyclability to the mid-price work chairs; it is unique because of different designs that takes into consideration back shape of men and women. It also permits individual control to achieve comfort. Leaking ceiling should be replaced to avoid water dripping that can damage equipments and materials in the office. It also poses hazard to the occupants in terms of mold growth and electrocuting. In general, there should be proper integration between building systems: interior (ceiling, floor, internal wall, furnishings, etc), mechanical (HVAC, power, service conduits, fire safety, control systems, lighting, plumbing, telecommunications, etc), envelope (wall, roof, windows, colour, textile, ornament, etc) and structural (system type, materials, column spacing, floor to floor height, span, bay size, etc) to achieve healthier office space. Additional benefit to be achieved from this integration is savings in energy and water consumption. Thus, occupants will be working in environmentally responsible indoor environment..

## **LIMITATIONS OF THE STUDY**

This preliminary study was done to have a pre-understanding of the occupants' perception of office environment. The authors acknowledge the fact that the questionnaire used for this study is very subjective and not very detailed enough. Furthermore, there may be other explanations (beside those provided under discussion

section) to the office occupants' health, comfort and perception of the environment. A detailed questionnaire would have been the one used in Environmental Protection Agency (EPA) Building Assessment Survey and Evaluation (BASE) study ([http://www.epa.gov/iaq/base/pdfs/2003\\_base\\_protocol.pdf](http://www.epa.gov/iaq/base/pdfs/2003_base_protocol.pdf) -see appendix F). The non-usage of objective measurement (i.e. use of instruments to measure pollutant concentrations) is also a limitation for the study. However, the correlation between the findings from the questionnaire and expert walkthrough gives some value to the method adopted to serve the purpose of this pilot study.

## CONCLUSION

This study was embarked on with the objective of determining IEQ conditions of an office space in Dubai, UAE. It was observed (through different methods adopted) that there are potential sources of stress on IEQ conditions of the office building both from indoor and outdoor. It was observed that inadequate maintenance, adjacent factory and activities of the building occupants contribute significantly to this stress. Solutions were recommended to turn the environmentally irresponsible office building to environmentally responsible office building. It is envisaged that this present study will lead to further, well planned and detailed studies that will include among other things, survey administration, objective measurements expert walkthrough and interviews) to address IEQ conditions in several air-conditioned offices (about 105 buildings) in all the seven Emirates in the UAE.

## ACKNOWLEDGEMENT

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# ETHICS OF SUSTAINABLE DEVELOPMENT IN SUB-SAHARAN AFRICA

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World Wildlife Fund claimed that humanity's demand on natural resources has double in the past 45 years, making it impossible to regenerate the earth's depleted resources. How much of this depletion can be attributed to sub-Saharan Africa's activities? Not much, according to the United Nations Framework Convention on Climate Change (UNFCCC), who stated that developed countries are the major contributors to the current high levels of greenhouse gas emissions for over 150 years. The effect is new concern and fear within the sub-region of the potential increase and effect of coastal and marine erosion with changes to sea levels, coastal land, wind patterns, rainfall and solar energy levels along the coastal regions. Sub-Saharan Africa and the built environment in particular need to address this issue urgently, ensuring that sustainability is dealt with in an equitable way. This paper maintains that environmental sustainability is fast becoming a moral issue, and that ethical and moral theories, practices and beliefs in addition to technical advancement should underpin society's behaviour and approach to sustainable developments. Dealing with sustainability in sub-Saharan Africa requires substantial financial resources and expertise, two of the scarcest commodity in Africa. The expectation is that developed nations should have a moral responsibility in supporting poorer countries to meet their obligations to cut carbon emission. The construction profession has made great strides in addressing sustainability both morally and technically, achieving low environmental impact buildings and sustainable communities. It is also well known that poorly designed developments can be damaging to the environment and threaten the health and welfare of inhabitants. In concluding, the paper acknowledges that users' wellbeing, development of sustainable communities, the maintenance and enhancement of natural cycles and biodiversity are important in achieving sustainable development, and that ethical approaches and behaviour can help us achieve this goal.

Keywords: environmental ethics, sustainability in Sub-Saharan Africa, sustainable development, construction sustainability.

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# EVALUATING THE CHARACTERISTICS OF WHOLE LIFE-CYCLE COST DATA IN THE NIGERIAN CONSTRUCTION INDUSTRY

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The scarcity of Whole Life-Cycle Cost (WLCC) data has led to the development of numerous models aimed at mitigating the problem. However, the usability of these models in the Nigerian construction industry is limited as there is no formal documentation of the sources, availability, reliability and consistency of WLCC data. In addition, no standard procedure for the collection, analysis, validation and presentation of WLCC data exists. This paper presents the preliminary findings of an ongoing research aimed at addressing these issues. A procedure for the collection, analysis, validation and presentation of WLCC data was first outlined. The procedure was then followed through, to evaluate the characteristics of WLCC data in the industry. Results show that there is no published information on maintenance and operating cost, life expectancy of building components, cost indices, and location adjustment factors. It was recommended that, concerted collaborative effort must be made by all stakeholders in organising and sponsoring research aimed at providing WLCC data in the industry. It was also recommended that, the method applied in this paper be adopted in the industry as it has the advantage of presenting WLCC data in a format suitable for use in existing WLCC models and also provides a basis for characterizing WLCC data in the industry.

Key words: whole life cycle costing, data attribute, Monte-Carlo method, probability density function, fuzzy membership function.

## INTRODUCTION

The economic evaluation of proposed building projects in Nigeria is predominantly based on initial capital costs rather than the Whole Life-Cycle Costs (WLCC). Little or no attention is given to the operating and terminal stages of proposed projects. This is inadequate since empirical evidence has shown that the occupancy cost (maintenance and operating cost) of a hospital building, for instance, could consume an equivalent of its capital cost every 2-3 years, and can continue to do so for forty years or more. Also, a school building could consume the equivalent of its capital cost every four to five years and remain in service for a century (DPWS, 2001). This signifies that the potential for cost savings at the operating and terminal stages of the building life have been largely neglected over the years.

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Recent developments in innovative procurement methods and the drive for sustainable building development have necessitated the evaluation of initial, maintenance, operating and terminal costs of proposed projects. Owen and Merna (1997) stipulated that, Public Private Partnership (PPP) projects are required to satisfy the value for money test which ensures that; the project can yield expected benefit over its operating life, have a residual life at the end of the concession period, and ensure optimal investment by minimizing over-design. Economic sustainability on the other hand requires that proposed projects ensure “fitness for purpose”, efficient allocation of resources (elimination of over/under investment) and the provision of economic options (Ellingham and Fawcett, 2006). These requirements are best evaluated using WLCC appraisal.

Dell’Isola and Kirk (2003) identified three additional factors that necessitate the use of WLCC. These factors are; facility obsolescence, operational staff effectiveness and Total Quality Management (TQM). Firstly, facilities must be designed to accommodate changes so as to guard against premature obsolescence due to functional, economical, technological and legal variations. Secondly, facilities must be operationally effective by organizing space to minimize wasted motions, maximize staff interactions and minimize total personnel requirement. Thirdly, facilities must be designed to meet TQM requirement which causes design professionals to address owner challenges of international competition, cost of operation and maintenance and overall business profitability.

It is in line with the aforementioned arguments that most developed nations have mandated the use of WLCC in the economic evaluation of proposed projects. Legislations mandating the use of WLCC in the United States of America have been passed since mid 1970s. In contrast, WLCC is rarely used in the developing countries except in the internationally financed projects like the World Bank assisted projects (Flanagan and Jewell, 2005). The poor utilization of WLCC has been attributed to the complexity of the process, cost of implementation, scarcity of reliable historical data, lack of standard methodology and framework, and the limitations of existing WLCC analysis tools (Ashworth, 1993; Seeley, 1996; Kishk et al, 2003; Flanagan and Jewell, 2005). Of these, scarcity of data presents the most challenge since hardly any meaningful inference can be made without reliable data.

Consequently, numerous research works have been conducted aimed at mitigating the data scarcity problem by shifting attention to subjective data. Sobanjo (1999) proposed an algorithm for the evaluation of subjective WLCC data based on Fuzzy Set Theory (FST). Kishk and Al-hajj (1999) proposed a WLCC framework which evaluates data on the basis of availability, tangibility and uncertainty. The framework utilizes the capabilities of FST, Artificial Neural Network (ANN), probability and statistics as risk analysis techniques. Based on this framework they proposed series of algorithms (Kishk and Alhajj, 2000a, 2000b, 2000c, 2000d) capable of assessing risk and uncertainty in subjective data. Boussabaine and Kirkham (2004) outlined a methodology for WLCC of mechanical and electrical services using Monte-Carlo simulation. Another algorithm proposed by Bala et al (2000a, 2008b) utilizes expert judgments in the absence of reliable historical data. These algorithms require the presentation of WLCC data either in the form of Probability Density Function (PDF) or Fuzzy Membership Function (FMF).

However, the usability of these algorithms in the Nigerian construction industry is doubtful. Firstly, there is no formal documentation of the sources, availability,

reliability and consistency of WLCC data in the industry. Secondly, the data, where available, may not be ready for use in existing algorithms. Thirdly, no standard procedures for the elicitation, analysis and presentation of WLCC data exist in the industry.

This paper therefore presents preliminary results of an ongoing work aimed at evaluating the characteristics of WLCC data in the industry. The authors believe that this will pave the way for identifying problems associated with WLCC data collection in the industry. It will also form the basis for generating WLCC data in a format suitable for use in existing WLCC models, thereby improving the usability of WLCC in the Nigerian construction industry.

The next section outlines the methodology followed in conducting the study. The findings are then discussed and conclusions drawn.

## RESEARCH METHOD

Figure1 shows a flowchart representation of a proposed procedure for the elicitation, analysis, validation and presentation of WLCC data.

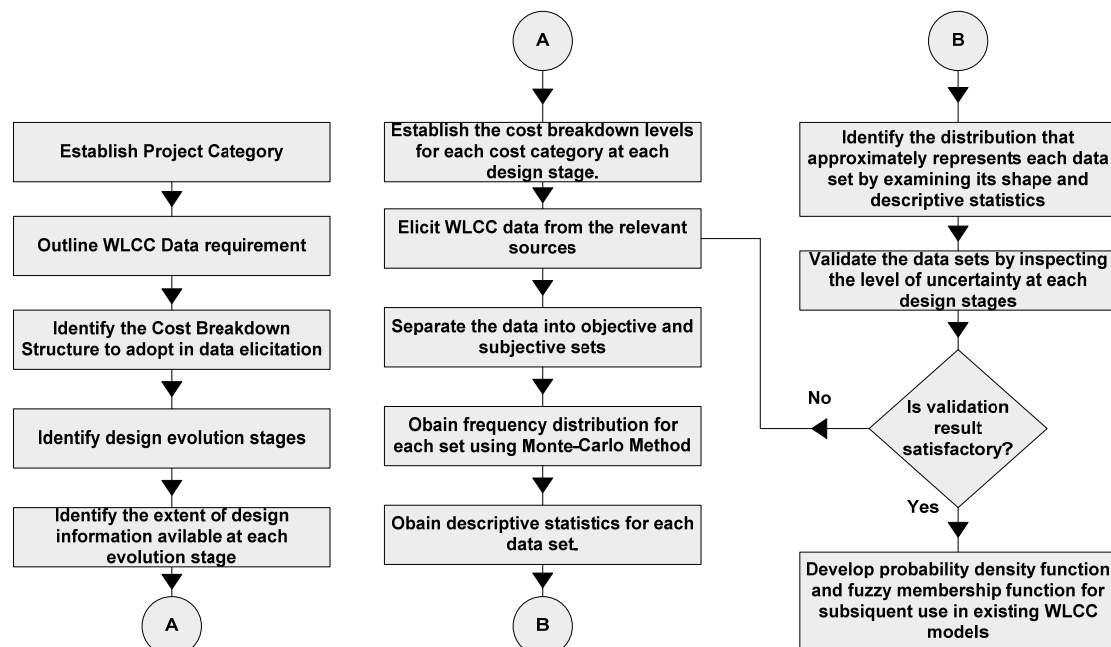


Figure 1: A Flowchart representation of the Procedure followed for the collection, analysis, validation and presentation of WLCC data.

The procedure outlined in figure 1 was followed in conducting this study. A project category was first identified. An ongoing project for the construction of proposed Shopping Mall was selected. The project forms the basis upon which data was collected for this study.

Secondly, the data requirement for WLCC was identified. Kishk et al (2003) categorized the data required for WLCC in to five groups. These groups are; economic variables, cost data, physical data, performance and quality data. However, occupancy together with performance (as defined by Kishk et al, 2003) and quality data were not covered in this study as they are subjective.

Thirdly, a Cost Breakdown Structure (CBS) that meets the WLCC data requirement was identified and adopted in this study. Flanagan and Jewell (2005) proposed a 3-

level comprehensive CBS that could be applied in WLCC analysis. A fourth level was introduced where necessary to enable component level data collection. The CBS has the advantage of harmonizing UK's Building Maintenance Information (BMI) Building Cost Information Service (BCIS), Chartered Institute of Public Finance, and Department of Environment CBS. Based on the CBS the cost data are categorized as; Initial Capital Cost (ICC), Annual Operating Cost (AOC), Annual Maintenance Cost (AMC), and Salvage and Residual Value (SRV).

Fourthly, the sequence of design evolution to adopt was also identified. This is necessary as the level of information required varies as the design evolves. Flanagan and Norman (1983) and Seeley (1996) identified the various WLCC and estimating tasks that could be performed at different design stages. The stages were based on a previous version of Royal Institute of British Architects plan of work. These stages were adopted in this work as they are widely reported in literature dealing with WLCC tasks. In addition the stages are very popular and widely used in the Nigerian construction industry. The stages actually covered were limited to pre-construction. They include Feasibility Stage (FS), Outline Proposal Stage (OPS), Scheme Design Stage (SDS) and Detail Design Stage (DDS). These tasks were carefully studied to establish the level of information required at each stage.

Fifth, the level of design information available at each stage was outlined as presented in Table 1.

Table 1: Information provided at each design stage

Design Stage	Information Provided
Feasibility stage	Location, Title and Purpose of proposed project. Project commencement date, proposed completion period and minimum Gross Floor Area.
Outline Proposal	Outline design showing the site layout in relation to the proposed main building, security and generator house. Outline of the proposed frame structure in addition to the information provided at feasibility stage.
Scheme Design	A scheme design for the main building showing each floor and the distribution of floor areas in to usable and circulation spaces. The number of units of accommodation and preliminary specifications of floor, wall and ceiling finishing. A site layout showing the positions of the main building, security and generator house. Outline sketch for services pipes and ducts. This information is provided in addition to that provided at the feasibility stage.
Detail Design	A detail design showing the plans, elevations and section of the proposed building. Detailed specifications of the finishes and components used. A site layout plan showing the detail of the external landscaping works. Detailed structural and services drawings. Detailed drawing for the generator and security house.

Sixthly, the levels of cost breakdown were identified as presented in Table 2.

Table 2: Cost breakdown level at different design stages

Design stage	Feasibility Stage	Outline Proposal	Scheme Design	Detail Design
Cost Category				
Initial Capital Cost	Level1	Level2	Level3	Level4
Annual Operating Cost	Level1	Level2	Level3	Level4
Annual Maintenance Cost	Level1	Level1	Level2	Level3
Salvage and Residual Value	Level1	Level3	Level3	Level3

Seventhly, data were collected using both questionnaire and interview. Questionnaire was used in the collection of cost data covering ICC, AOC, AMC and SRV. Different questionnaires were used at different design stages. Each questionnaire was divided in to three sections. The first section elicits data on the respondent. The second section elicits cost data from the respondent while the third section provides requisite information on the proposed project based on which the respondent will provide the cost data in section two. The interview on the other hand was used to investigate attributes 1 to 3 and the objectivity aspect of attribute 5 as described on table 3 below.

Table3: Data attributes and their descriptions as used in this study

S/No	Attributes	Description
1	Source	This refers to the origin of the data. E.g. professional or manufacturer data sources.
2	Availability	This refers to the existence of a system for the collection, analysis and storage of WLCC data(whether subjective or objective)
3	Consistency	This refers to the existence of a specific format or CBS used uniformly at different data sources.
4	Distribution	This identifies the basic shape of the WLCC distribution. The shape is classified as either; uniform, triangular, normal, skewed and irregular distribution.
5	Reliability	This refers to the objectivity in WLCC data and the ability to obtain factual results using the data.

Lastly the distributions for level 1 data categories were obtained by constructing frequency distribution directly from the data while Monte-Carlo method was used to build the frequency distribution for level 2 to 4 sub-categories. Each subdivision under a cost category was presented in a tabular format alongside the data collected. Cost data was selected randomly from each sub-division to form a data set under the cost category. The data set are then summed up to obtain the total cost for the relevant category. The procedure is iterated 25000 times for each cost category or sub category as the case may be. Frequency distribution is then obtained at the first level category. The same procedure was followed to obtain the distribution for the discount rate. Equation 1 was however used in the computation of the discount rate during the iteration. Descriptive statistics and Normal Probability Plot (NPP) were then constructed for each distribution to check for uniformity, normality and skew ness in accordance with the procedure outlined by Levine et al (2005)

$$d = \frac{b - i}{1 + i} - 1$$

Where b is the lending rate, i is inflation rate and d is the discount rate.

The reliability of the data was ascertained by evaluating the uncertainty in the data sets using the coefficient of variation. The reliability test is that the uncertainty in WLCC data should diminish as design passes from feasibility to detail design stage. This phenomenon have been asserted by many researchers like, Dell'Isola and Kirk (2003), Boussabaine and Kirkham (2004), Flanagan and Jewel (2005) amongst others.

## RESULTS AND DISCUSSION

Figure2 and table 5 show the distribution and descriptive statistics for the WLCC data under study respectively. The properties of these distributions confirm previous assertions by other researchers. Boussabaine and Kirkham (2004) emphasized that,

firstly, minimum and maximum values could be specified for cost variable which suggests that the distribution for the cost variable is close ended. Secondly, the cost variable could take any value between these limits which suggests that the distribution for the cost variable is continuous between the limits. Thirdly, a likely value could be assigned to the cost variable which suggests that the distribution for the cost variable should have a convex shape. Another property identified by Beeston (1974) was that the distribution for cost variable should be positively skewed. He argued that higher values tend to be further above the mean than lower values below it. While the first three assertions have been satisfied by all the distributions in figure 2, not all the distributions satisfy the last assertion.

Table 6 shows the sources, availability, consistency and objectivity of the data under study. Unlike in most developed countries, inflation rate is highly unstable which results to fluctuating discount rate. The discount rate as could be observed from plate 3 of figure2 can take both negative and positive values depending on the corresponding values for inflation and borrowing rate. Result shows that there is 53% chance that the discount rate could be negative. This explains why it is almost impossible to obtain long term loan from financial institutions.

Cost variables like ICC, AOC, and AMC are generally available. However, while ICC data is consistent, objective and reliable AOC and AMC data are inconsistent, subjective and unreliable. Uncertainty in ICC data seems to decrease as design evolves. In contrast, uncertainty in AOC data fluctuates while it increases with AMC data as design evolves. This is contrary to general expectation as uncertainty should reduce with increasing information. The situation is so possibly because, detailed information on ICC is available from professional institutions and organizations while no such information exist for AOC and AMC.

Data relating to SRV of buildings are subjective and inconsistent. While some respondents consider the value of land only as the residual value of the building, others consider both the value of land and the salvage value of the building itself. Even so, different approaches were taken in determining the salvage value of the building. For instance, while some depreciate the reinstatement value of the building others depreciate the perpetual income expected from the property. In spite of these however, variation of uncertainty in the SRV data as design evolves appear to be normal. It reduces as transition is made from FS to OPS and then stabilizes in the subsequent stages as could be observed from figure 3.

Data relating to component life expectancy and location and time adjustment factors are inconsistent and subjective. While location and time adjustment factors are not available, life expectancy data is available but unreliable. Unreliable in the sense that similar brands of product with the same performance rating but varying qualities abound in the market. Moreover, no published data on either the life expectancy of building components or time and location adjustment factors exist in the industry. This is a serious problem as all cost data must be adjusted for time and locational differences.

The method applied in this study has the advantage of presenting WLCC data in the form of frequency distributions. These distributions could be transformed into either Probability Density Functions(PDF) or Fuzzy Membership Functions(FMF) for subsequent use in confidence index approach proposed by Dell'Isola and Kirk(1981), Simulation models proposed by Boussabaine and Kirkham(2004) and Fuzzy models proposed by Sobanjo(1999), Kishk et al (2000), and Bala et al (2008).



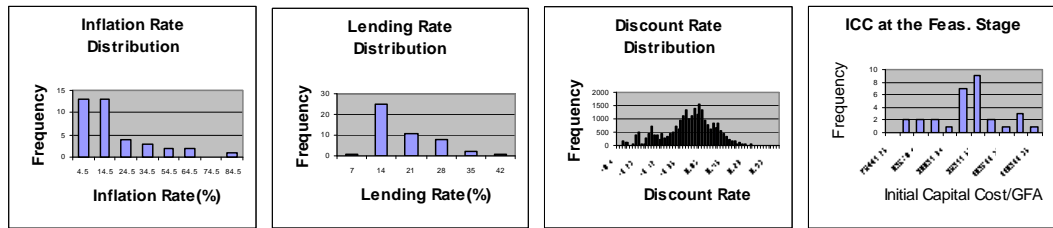


Plate1

Plate2

Plate3

Plate4

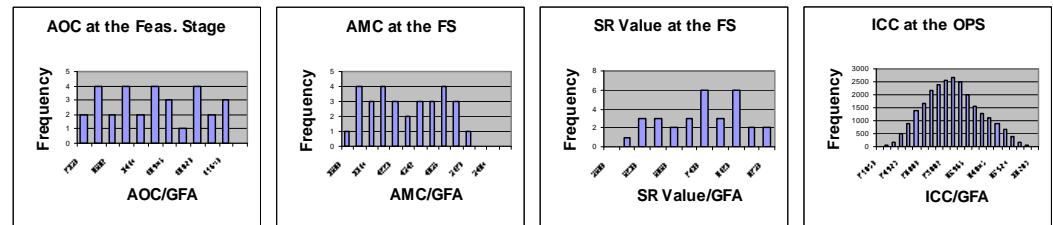


Plate5

Plate6

Plate7

Plate8

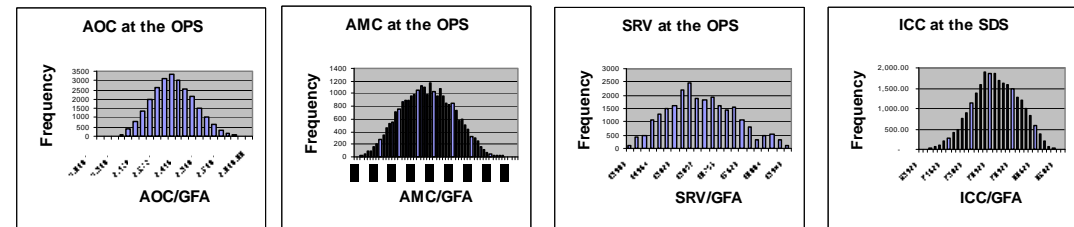


Plate9

Plate10

Plate11

Plate12

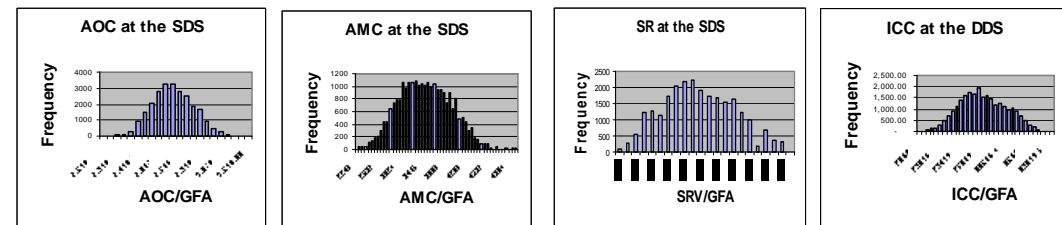


Plate13

Plate14

Plate15

Plate16

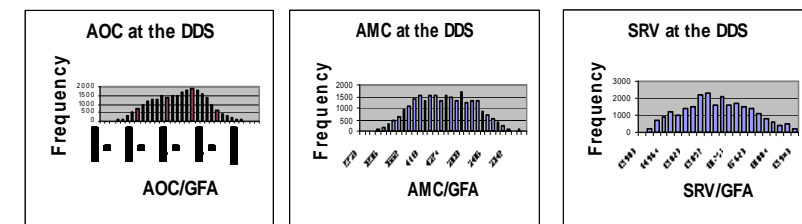


Plate17

Plate18

Plate 19

Figure2: Frequency distributions for WLCC data at various design stages.

Table 5: Descriptive statistics for WLCC data at different design stages (All costs are expressed in Nigerian naira)

Design Stage/ Economic Variables	Cost Category	Approximate Distribution	Mean	Median	Min. Value	Likely Value	Max. Value	Standard Deviation	COV
Feasibility Stage	Initial Cost	Triangular	93786.21	93820.00	76450.00	96919.68	110650.00	8534.08	9%
	Annual Operating cost	Uniform	9584.71	9555.00	7920.00	-	11580.00	1168.70	12%
	Annual Maintenance cost	Uniform	4287.26	4260.00	3560.00	-	5130.00	459.23	11%
	Salvage and Residual	Triangular	7325.00	7410.00	5890.00	7325.00	8740.00	819.42	11%
Outline Proposal	Initial Cost	Normal	79899.03	79755.50	71453.60	75261.80	89315.80	3288.00	4%
	Annual Operating cost	Normal	2308.85	2303.5	1864.50	2291.50	2811.50	144.20	6%
	Annual Maintenance cost	Normal	3530.60	3526.00	2297.00	3520.00	4995.00	480.42	14%
	Salvage and Residual	Triangular	15923.88	15795.00	13248.00	16330.00	19125.00	1287.82	8%
Scheme Design	Initial Cost	Normal	77877.85	78282.10	69372.70	79773.50	82991.90	2514.05	3%
	Annual Operating cost	Normal	2669.48	2663.50	2211.50	2619.50	3156.50	142.31	5%
	Annual Maintenance cost	Normal	3448.015	3434.00	2246.00	3093.00	5046.00	470.89	14%
	Salvage and Residual	Triangular	15948.55	15840.00	13230.00	15230.00	19410.00	1272.20	8%
Detail Design	Initial Cost	Normal	77688.27	77487.60	70370.40	80452.20	84946.40	2598.04	3%
	Annual Operating cost	Normal	2649.60	2665.50	2105.50	2681.50	3310.50	204.56	8%
	Annual Maintenance cost	Normal	4467.84	4470.00	2756.00	4530.00	6198.00	632.58	14%
	Salvage and Residual	Normal	16167.93	16120.00	13260.00	15700.00	20410.00	1357.69	8%
Economic Variables	Inflation rate	Irregular	19.67%	13.90%	3.2%	5.4%	72.8%	16.69	84%
	Lending rate	Triangular	15.63%	11.88%	6%	8%	36.06%	7.57	48%
	Discount rate	Normal	-2.5%	-0.7%	-0.39	0.04	0.32	0.13	-5%

Table 6: Attributes of WLCC data

WLCC Data	Data Source	Data Availability	Data Consistency	Data Objectivity
Inflation rate	CBN Statistical bulletin,2008	Available	Not applicable	Objective
Lending Rate	CBN Statistical bulletin,2008	Available	Not applicable	Objective
Discount rate	Computed	Available	Not applicable	Objective
Cost of Land	Estate management firms	Available	Consistent	Objective
Professional fees	Government approved scale of fees	Available	Consistent	Objective
Construction Price for Building	Quantity surveying firms	Available	Consistent	Objective
Cost of Statutory Consent	Development authority	Available	Consistent	Objective
Capital Gains Tax	Internal revenue departments	Available	Consistent	Objective
Value Added Tax	Internal revenue departments	Available	Consistent	Objective
Components Life Expectancy	Manufacturers/ Suppliers	Available	Inconsistent	Subjective
Location and time adjustment factors	Quantity surveying and Estate Management firms	Available	Inconsistent	Subjective
Initial Capital Costs	Initial Capital Cost(Level 1)	Available	Consistent	Objective
Annual Operating Costs	Estate Management firms	Available	Inconsistent	Subjective
Annual Maintenance Costs	Estate Management firms	Available	Inconsistent	Subjective
Salvage and Residuals	Quantity Surveying firms	Not available	Inconsistent	Subjective

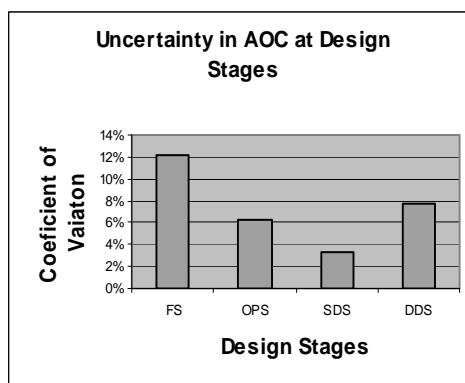
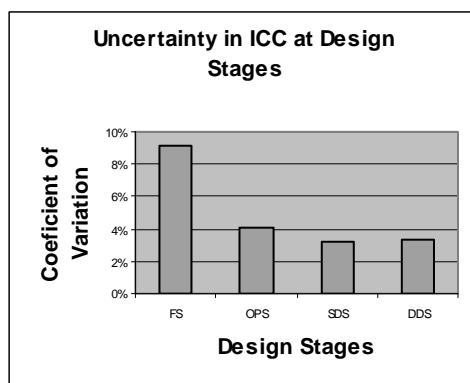


Plate 1

Plate 2

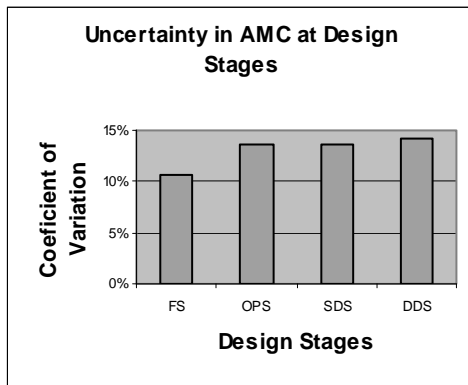


Plate 3

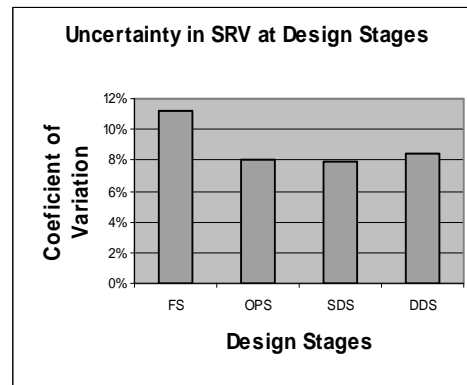


Plate 4

Figure 3: Variation of uncertainty for WLCC data with different design stages.

## CONCLUSION

This paper has presented preliminary result of an on-going research on the sources, availability, consistency, and reliability of WLCC in the Nigerian construction industry. Result suggests that a lot needs to be done to improve access to and reliability of WLCC data in the industry. Lack of published operating and maintenance cost data, life expectancy of building components, cost indices, location adjustment factors and standard methodology are a serious bottleneck to the application of WLCC in the industry. Unless a drastic effort is taken to mitigate these problems, the entire WLCC process would be highly subjective and the accuracy and reliability of results would be suspect.

Concerted effort must be made by professional institutions and organizations like Nigerian Institute of Building, Nigerian Institute of Quantity Surveyors, The Nigerian Institute of Estate Surveyors and Valuers, The Nigerian Society of Engineers, and Facilities Management Association on one hand and government agencies like Building Research Institutes, Standard Organization of Nigeria (SON) and National Bureau of Statistics on the other to collaborate, organize and sponsor research aimed at providing WLCC information to the industry. In addition, SON must exert extra effort to ensure that fake products do not infiltrate the industry market so that the reliability of manufacturer's data could be improved.

Moreover, the Authors recommend the use of the procedure followed in this study for the collection, analysis, validation and presentation of WLCC data in the industry as it has the advantage of generating frequency distributions for WLCC variables which could be transformed in to PDF or FMF for subsequent use in confidence index approach, simulation and fuzzy models. A possible limitation of the procedure though, is that it relies on the CBS adopted which may lead to the obtainment of different results for different CBSs. Thus an investigation in to the influence of CBS on the result needs to be conducted.

Finally as the result presented in this paper are preliminary, more data needs to be elicited and analyzed in order to obtain better representation of WLCC data in the industry. Although the efficacy and robustness of the recommended procedure needs

to be empirically established, it provides a basis for consistent and coherent characterization of WLCC data for use in the Nigerian construction industry.

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# EVOKING THE GREEN-SHIFT IN THE BUILDING INDUSTRY FOR SUSTAINABLE DEVELOPMENT IN NIGERIA

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Global issues in the field of environment and energy is one of the problems which pose serious threats to the world today. The present situation of (EE) Energy Efficiency in Nigeria with regards to the policies and the concern of the environment and development in the third world has become the rhetoric of developmental studies. The 21<sup>st</sup> century, calls for a lot of challenges in sustainable Development, With the rate of climate change on the rise and building industry been one of the major contributor to the depletion of Ozone layer, emitting about 35% of CO<sub>2</sub> into the atmosphere and responsible for 40% of the world's total energy, there is need for stake holders to act now. The paper is focusing on the need to create an awareness of the new paradigm shift in building industry on the issue of sustainability where green technology is the new idea that needs to be applied to design and construction of buildings. A Review of; the World Green Building (WGB) movement was carried out with the positive impacts on building designers and buildings to a new paradigm and dimension, the Malaysian programmed on RE (renewable Energy) and EE (Energy Efficiency) which started in 2000, with LEO (Low Energy Office) building demonstration, to the establishment of the GBIM (Green Building Index Malaysia) in 2009, were compared with the present situation of Energy utilization and conservation in Nigeria. Although there has been a campaign on the issue of global warming and climate change with Nigeria's adaptation strategy, which will necessitate it being mainstreamed into its developmental policies and the Vision 2020:20, but the frame work for local action in terms of policies that would move for the establishment of a green building index for the building industry in Nigeria as well as ministry for green technology is not in place. Energy is needed for continuation man's daily activities, but this energy needs to be managed so that it can serve us and the future generation. The proponents of climate change argue that affordable energy –in the form that is currently available – is also the cause of climate change, this calls for awareness and crave for applicable solution to the issue of sustainable development in which the Green -shift in the building industry is part of the solution to the issue of sustainability.

Keywords: climate change, energy efficiency, sustainability, green building.

## INTRODUCTION

There has been evidence of climate change in Nigeria and the consequences well elaborated (Okali, 2008), with Nigeria contributing 0.79 per cent (0.79%) of CO<sub>2</sub> into

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the atmosphere an estimation of 2.1 Metric tons/person this exclude the land use change according to world research institute (WRI 2005). We find ourselves to be among the most vulnerable to the effect of climate change, this call for local action to be taken. Massive public awareness and in increase in knowledge base are two key factors needed to be addressed. Building industries by the end of 2010 would have used up to 40% of total global energy and in return 3800 mega tones of CO<sub>2</sub> would be released into the atmosphere (Achuythan and Balagopal, 2006).

To reduce green house gas (GHG) emission at least by 5% by 2012, in order to tackle global warming and climate change, new and old buildings construction require low-energy criteria (Chlela et al., 2009).” As climate change negotiations advance, it is becoming increasingly clear that there is a greater need to shift the focus on developing countries, since the international negotiations have not adequately addressed other priorities for sustainable development, support for adaptation activities and technology transfer. This will be because affordable and accessible modern energy services along with poverty reduction are essential to achieve sustainable development “(Reddy and Assenza, 2009). Green- Architecture aims at having buildings and their environs with high level of resource efficiency. This is achieve by using energy efficient materials and construction techniques, harvesting and recycling of water and effective use of natural elements like air and light. It incorporates not only the ordinary values of Architecture (Strength, Functionality, Aesthetics, Cost, and Comfort) but, also the environmental dimensions of Green buildings (Energy-efficient, Sustainability-concepts, Holistic- approach).

Sustainability development has clearly taken on a global dimension, even in recent years it has recently been acknowledged that there is a close mutual interaction between local and global process which requires; networks, knowledge and local milieu. This will stir the world toward achieving goal of sustainability (D’Auria, 2001). It is of paramount importance that, the use of non-renewable source of energy be checked for its consequence in Carbon-dioxide emission which depletes our climate. A radical movement to decrease the use of much energy in buildings and rely on the renewable source of energy should be put in place; this could be referred to as ‘Energy- conscious Architecture’.

The war against climate change pitches mankind against a global threat that surpasses that of terrorism, climate change has led us into an era in which war and conflict are endemic. Buildings are in the front line of the battle against climate change. Either they change fast and radically or we lose the war. It has been established that buildings account for 1/4 to 1/3 of the primary energy cost which has direct influence on climate change. Therefore to evaluate buildings performance based on only energy aspect is not adequate to create a net- zero energy or a net-zero carbon building, a great deal of innovations will need to craved to address the fundamental and practical question raised from the development of various new building; materials, technologies and system. (Roaf, Crichton and Nicol, 2005)

## **SOURCE OF ENERGY IN NIGERIA**

The three main sources of energy in Nigeria are; Traditional, Conventional and Alternative (Thomas, 1980). The high energy demand by the world’s population has made it mandatory for us to preserve and conserve energy as well as to source for alternative to be used in our daily lives especially buildings in Nigeria. This is because historically our traditional buildings encourage energy conservation and exhibit a character of green approach to architecture. The advent of international- style



and our quest for development and lifestyle, saw an era where buildings were constructed neglecting original standards and requirements. Much energy was required to cool, light, ventilate and this required the use of fossil fuel which is non renewable and contributes an amount of CO<sub>2</sub> to our atmosphere.

### **Energy utilization and conservation in Nigeria**

The method in which buildings are designed and built in Nigeria compliments conservation especially in the rural area; this is as a result of the limited resources. In the rural area the shapes, forms and functions are still very traditional and materials used are predominantly clay and mud. At the late end of colonization, traditional buildings were not preserved and subtly destroyed, especially in the metropolis. The discovery of oil and prosperity that comes with it saw a large influx of ideas and styles in building from international style to the postmodern style as well as high-tech. Most of these buildings did not consider the standard and requirement for building them in the various localities and a great deal of energy was required in buildings to provide; cooling, lighting and other gadget requirements. The energy sources, after all is exhaustible and coupled with the limitation in technological base, policy are needed to enhance the conservation of the energy source (Thomas 1980).

### **Effect of climate change in Nigeria**

Late onset of the rains around (1970 - 2000) was observed in Northern and Southern part of Nigeria, which is a sign of precipitation change. Extreme weather events: Droughts and floods were experienced in some part of the country. NEST (Nigeria Environmental study Team) has identified a framework at the local and National level that will be implemented, in order to address the issue of climate change.

One of the actions is massive public awareness (Okali, 2008). Climate change is a complex phenomenon and requires mutual action among; climate environment, economy, politics, institutional, social and technological processes. The hostile effect of climate has made Nigeria one of the vulnerable nations to desertification and soil erosion. It has an adverse impact on our; agriculture, energy, biodiversity and water resources.

### **Vision 2020: 20 a mile stone for Nigeria energy sector**

In 2005, Goldman Sachs looked at the economy of the world and made a prediction on the world economy potentials, he predicted that most economy will outplay the big economy if they continue on the path of growth rate, Nigeria will be the 12<sup>th</sup> largest economy by 2050, this made the Nigeria government plan for 2020 in lieu of 2050 prediction (Nwachukwu, 2009). For developmental growth the issue of energy efficiency was not established, except the issue of generation and deregulation of the downstream oil sector (Soludo, 2007)

## **PHILOSOPHY OF GREEN BUILDINGS**

A Green building is a high-performance property that considers and reduces its impact on the environment and human health. A green building is designed to use less energy and water and to reduce the life –cycle environmental impacts of the materials used. This is achieved through better choice of site, design, material, selection, construction, operation, maintenance, removal, and possible recycling. (Yuldelson, 2008). The green building revolution is part of a paradigm shift toward sustainability, a growing realization that current ways of living, made possible mainly due to cheap and abundant fossil fuels, are not sustainable in long term. A philosophical concept on

sustainability and green building is what is required for Nigerians with a population of over 160 million and a growing rate of over 2% per annum, is extremely vulnerable to the adverse effects of climate change. The combine effects of the desertification and soil erosion have impact on Agriculture, energy, biodiversity and water resources. Most serious threat to the poor and it struck at the root of the foundation of the world economic system- energy use (Okali, 2008).

Low energy or energy efficiency provides us with an easy way to combat climate change. As we develop our use of natural resources, more will need to live and work in the city. Green building s will become the new vernacular, for it simple economical forms require less materials, energy and maintenance.

Cost efficiency is a prerequisite for sustainability and there are a number of key aspects to the design of green buildings;

1. Conservation of energy and resource
2. Ecological foundations and minimal site intervention
3. Reduction of infrastructure; roads pipes, lighting
4. Elimination/reduction of materials and resources wastage.
5. Elimination/reduction of toxic materials and process.
6. Use of renewable/biological material energy.
7. Use of safe, recycled materials and products.
8. Vapour-diffusive-air and wind tight construction
9. Super insulation and ecological thermal energy storage
10. Use of natural (passive) heating and cooling
11. Use of natural lighting (for heat and energy saving)
12. Minimization of electro-magnetic fields
13. Long life, low-maintenance, robust design
14. Adaptable, inclusive (access for all) design
15. Green surrounding-design with nature and climate

Any building designed to function within the context of; climate, environment and culture, can be called “Green” (Snelling, 2009).

### **World green building movement and the green building index**

Concerning the environmental problems many countries introduced EE as an option but because the nature of the issues are too broad; it is still too far to accomplish. The Green building Index (GBI) is an indicator providing empirical and numerical basis for evaluating building performance for calculating the impacts of building on the environment and society. Renewable energy is considered viable to be integrated within; building design, construction guidelines, recommendations for sustainable practice of renewable energy and applications are becoming increasingly important and significant.

The USGBC (United State Green Building Council), in 2000 unveiled the Leadership in Energy and Environmental Design (LEED) green building rating system for public use. LEED was the first rating system in the United State to hold commercial projects up to scrutiny for the full range of their effects on energy and water use, resource conservation, land use, and indoor environmental quality. Green buildings reduce carbon emissions by about 40 percent compared to conventional buildings. Prior to LEED, most evaluation systems, such as the Environmental Protection Agency’s Energy Star program had focused exclusively on energy use, but LEED has defined what it means for a building to be sustainable, and the various ways to approach creating green buildings.(Yudelso, 2008). Since its establishment in 2002 the WGB

has provided an important non political global forum for discussion and promotion of the sustainable transformation of the global property industry.

### **Conceptualization and theoretical frame work on green buildings.**

Creating awareness for the effective practice of sustainability in the Nigeria building industry.

Advocating for the stake holder; Architects, Engineers, Builders, Quantity-surveyors and the Client including the user to seek and apply knowledge of green-building on both new constructions and renovation to be carried out. Although the building industry is responsible for; 40% of the world's total energy, 30% of consumption of raw materials, 25% of timber harvest, 35% of world's CO<sub>2</sub> emissions, 16% of fresh water withdrawal, 40% of municipal solid waste, 50% of ozone- depleting CFCs (Chlorofluorocarbons) is still in use, 55% of timber cut for non fuel uses, 30% of the residents sick building syndrome.

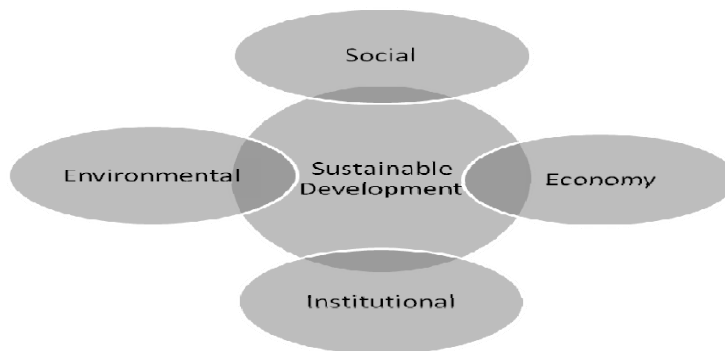


Fig. 1 The modified orthodox model of 'balance' in sustainable development (source; Moughtin and Shirley 2005)

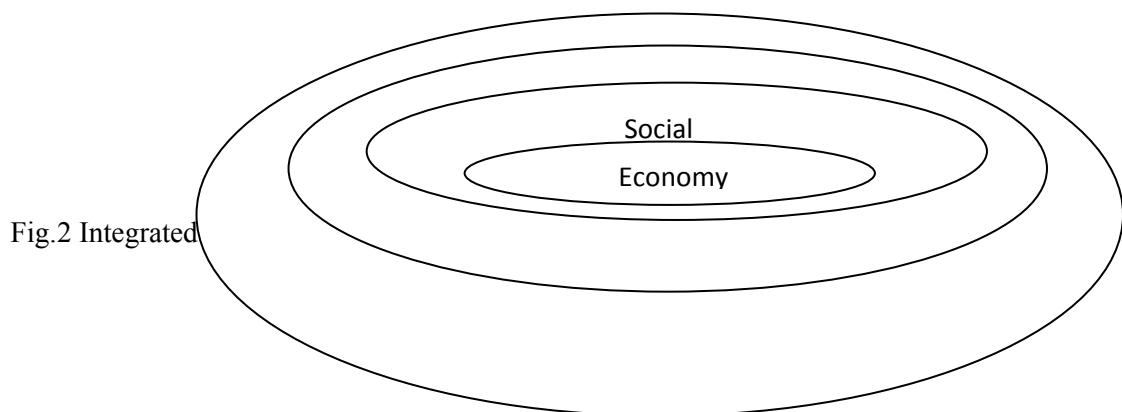


Fig.2 Integrated

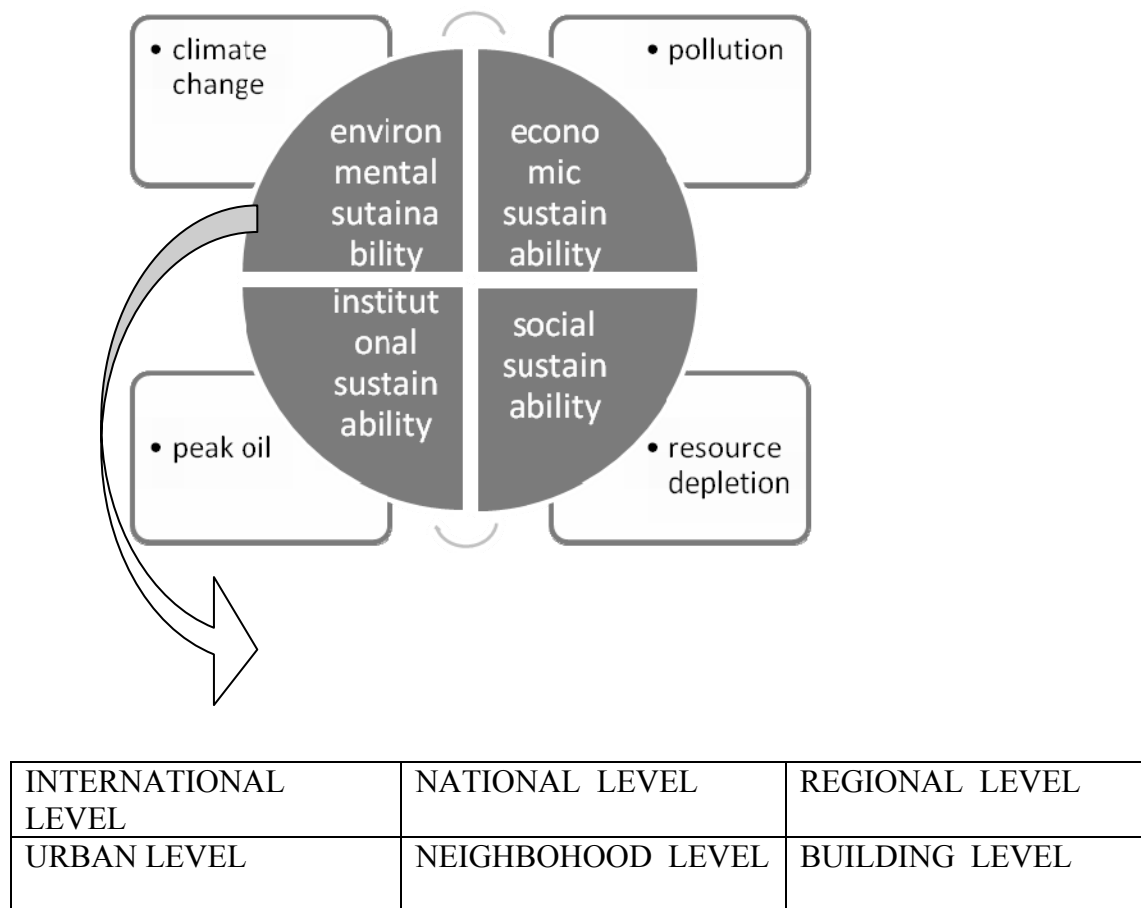


Fig. 2 A conceptualization concept of sustainability

### Malaysia quest for sustainable energy development and Green Building Index Malaysia (GBIM)

Malaysia has well-established set of plans that are laid out for implementation every five (5) years. The 2006 to 2010 plan addresses the issue of energy vividly, which all started in the 70's with the strategy of implementing energy policies which had a target of renewable energy providing 5% of electricity generation by the year 2005.

Sustainable building program started with energy efficiency (EE) and renewable energy (RE) program beginning in the year 2000 with Low Energy Office (LEO) building demonstration project commissioned in 2003 and followed by national Malaysia Building Integrated photovoltaic (MBIPV) program started in 2005. The newly launched Green Building Index Malaysia (GBIM) in 2009 is another milestone for Malaysia towards green development after a long effort primarily initiated by the Malaysia energy policies and promotion on RE and EE.

LEO is focuses only on low energy which directly contributes to the reduction of CO<sub>2</sub> emissions. ZEO of PTM (commissioned in 2006) has further proved in achieving low energy demand by tremendous Building Energy Index (BEI) reduction as low as 30kWh/sq.m/year. ZEO demonstrates both RE and EE features successfully.

The development and utilization of renewable energy has been started and will be further intensified. The Malaysian government is expected to generate from municipal waste, solar hybrid systems and biomass based cogeneration new sources by 2010.

There would be other development of power to be generated from solar, fuel cells and hydrogen and other sources of energy such as wind, solar and bio-fuel from palm oil will be develop through intensive R&D. A road map has been drawn to target the year 2050 and financial initiative been introduced in the form of research funding through the Ministry of Science, Technology and Innovation (MOSTI) where alternative energy has been given a topmost priority (Sophian, et al. 1995, 2000).

In the series of developmental plan been laid by the Malaysians, energy efficiency (EE) was a major priority since it features in both industrial and commercial sectors. The Malaysian standards department has produced a guideline for energy efficiency (EE) and the use of renewable energy (RE) in non-domestic buildings called the MS 1525 introduced in 2001. It is planned that the MS 1525:2007 will be incorporated in the uniform Building By-Laws (UBBL) to improve EE in building sector. (Jamulidin, et al.)

This set of plans which is the most current and is known as the 9<sup>th</sup> Malaysia plan 2006-2010 had five thrust areas of which are to, elevate the economy system to a higher level, to raise the capacity for knowledge and innovation and nurture “first class” mentality, to address persistent socio-economic inequalities constructively and productively, to improve the standard and sustainability of life and to strengthen the institutional and implementation capacity. The government of Malaysia is well inform on the issue of *peakoilism* and the importance of sustaining the quality of life for the needs of the population and the same time to manage Malaysia’s resources wisely. This entails; ensuring the protection of the environment, enhancing energy sufficiency and efficiency, diversification of energy resources, increasing water efficiency and providing better transport and reduction of fuel wastage, access to affordable housing and healthcare

## **ADAPTING THE GREEN TECHNOLOGY AND INITIATIVE FOR FUTURE DEVELOPMENT IN NIGERIA**

The emergence of two most serious threats that confront the world today are: the threat to the atmosphere and the biosphere, which are fundamentally urban and the solution is known and clearly understood (Low, et al.). This require the emergence of a green building movement in Nigeria, and the world as a whole especially those countries who have not started the movement (Achyuthan and Balagopal, 2000).

The world green building (WGB) movement started in early 1990 due to world global warming and climate change. It is a union of councils from around the world that aims to accelerate global sustainable building practices. The world green building council (GBC) has the sole authority to appoint and direct the formation of green building councils throughout the world, launched 1988 by David Gottfried, founder of US Green building council. Various affiliated bodies are; Green building council of Australia (GBICA), United State green building council (USGBC), New-Zealand, and South-Africa have adopted the Green Star rating tools with modification to suite the unique conditions of their countries as well as the implementation stage for the completion of Malaysian green building council MGBC. Most of the countries mentioned above are developed nations except for Malaysia which is at the height of the fully implementation of the Green Building Index Malaysia (GBIM), what about other developing countries? (Jamaludin, Kandar and Shafagat, 2010).

## **Policies for developing countries a beneficial movement for Nigeria**

Developing countries need to integrate both development and change climatic policies that have to be embedded in its development policy and the use of SDPAM (sustainable development policies and measures). This is of the global action on climate change.

Kyoto protocol

Clean development mechanism (CDM)

Carbon trade- certified emission trading, regulated and unregulated

There are cost implications, which need to be compared with clean energy system against social and economic benefits. Normally an additional cost for incorporating green design will only be 5% to 6% of the total cost. This will be offset by the reduced cost of operation and maintenance that is, cost of lighting, water supply and so on.

The world congress of Architects (United International of Architects) (UIA) and American Institute of Architects (AIA) met in June 1993 had a declaration of interdependence for a sustainable future. This declaration affirms energy efficiency, sustainability concept and holistic approach related to the natural, artificial and social environments. In accordance with this declaration, international council for building research, innovation in building and construction (CIB W082) advocated new paradigm in global context that can be interpreted as key issues using the key verbs; **reduce, conserve, and maintain**. This can be translated into the three 'R's of urban sustainability; Reduce, Reuse and Recycle. (Edwards, 2005) this has been a long advocate of environmentalist, but the fourth 'R's (Recover) was added more recently making them four 'R's. The adoption of the four 'R's will improve the quality of life.

Sustainable development is the development that meets the needs of the present without compromising the ability of the future generations to meet their own needs (Brundtland Report, 1987).

A building should be energy efficient, because it is the area that has the highest potential to improve efficiency as well as job creation. This could involve; Renovation and New construction of; schools, public buildings and other sectors that are being run by the government.

(Kunszt, 2002) A further issue is the justification of the critics of globalization that a wide range of; countries, region and cities would lose their identity. Architecture has a key-role in the preservation of identity, which partly requires the careful protection of our monuments and the refusal of architecture which has no message for the mind, no motivation of spirit, but with this proponent of identity shall we compromise our precious environment and the world as a whole to the effect of climate change.

## **Benefits of climate change**

The modalities of climate change vary from country to country, region to region. The advanced countries which cause more of the depletion vary from that of other developing countries. The starting point should be development issues that are vital to the economic development and how this can be achieved without harmful effect on the environment. The C<sup>3</sup> plants, Wheat, Rice, Soy beans thrive greatly on concentration of CO<sub>2</sub> in laboratory experiment (Collier, 1997). Most scientist have argued that climate change is a natural phenomenon that we should see the climatic history of the world from ice-age to the computer age, while others claimed that

human activities are major causes. Three considerations should be given to the issue of climate change;

Focusing on the minimizing the demerit of climate change.

Adaptation to the situation – economist point of view

Prevention of the situation – environmentalist point of view

The construction industry has a turn – over of US \$3 Trillion annually. A world wide transition to energy efficient building would create millions of jobs as well as “greening”. Over 100million people are employed in the building sector, about 4million green jobs could be generated in Europe and U.S.A. alone. While the potential is much higher in developing and transition countries, for countries in transition normally have large stocks of inefficient buildings and Nigeria which has a population of over 140 million, the construction sector yearning to annex. Abuja, the capital city that is in the early stage of development and Lagos the most vulnerable state in term of effects of climate change in Nigeria, with the later trying to achieve a mega city by 2020,would need to be part of this great movement in its new development.

### Technology advancement

Artisan would have to be IT literate, low carbon buildings, carbon - foot printing, health and safety would be of priority as well as a mobile computing and ICT. Architecture has to do with preservation of culture and heritage but principally sustainable Architecture is based on the principles of healthiness, energy – efficiency, ecological and high social and cultural standards (Kibert, 1999).

### Probably advances

Supply side: industry, technologies and skills (driven by ovation and R&D)	Key drivers in surrounding- socio-technical and economy system	Demand side: user’s customers and clients (driven by new and changing expectations.
-docile and aggressive materials -low waste to no waste -super-automatic construction -IT- literate artisans	-Planning policy -Energy legislation -Building regulations -Customer choice -Property values -Energy cost -Insurance prices -Efficiency -Quality assurance -Servitisation	-Super-resilient building -Single integrated professional Body. -Measure or perish -License to operate

Fig. 3 (source), Adopted from (Glass et al., 2008)

The entire idea is to de-carbonize our modern material, that’s the major material we use in building; Cement, glass and steel as well as minimizing the embodied used in the construction of our buildings. This will surely lead to achieving sustainability in the building sector

## CONCLUSION

The case of climate change has been linked to; human activities, the building industry account for 40% of world's total energy and emitting 35% of world's CO<sub>2</sub> into the atmosphere, most buildings in Nigeria especially high – rise and office buildings utilize a lot of energy in an aim to achieving effective ventilation, comfort and good health. To achieve this in a convectional building, it requires a lot of energy and most of the energy used in Nigeria are non renewable. For the energy from the renewable source is not enough to serve the nation and therefore have adverse effect on our climate as a whole. Green design can work its wonders on any scale, this is by adopting organic buildings; this is a building that would have a kind of holistic approach in its pattern, that would conserve energy and nature as a whole and consider cost as well. For this to be achieved there is a need to create awareness on the shift to green building both in our educational curriculum and in the field of our built environment and much concern and effort given to formulating the policies, strategies to implement programs to develop green building and its related technology.

The context of green architecture can be divided into two; traditional and Modern. Traditional aspect of green architecture, both traditional and vernacular forms of architectural design have been green even before writing was invented, while modern green has to do with; de-carbonizing materials use for construction, the use of renewable energy, utilizing the four 'R's in urban sustainability; *Reduce, Reuse, Recycle, and Recover*. Most of our resources need to be conserved and manage, so that the available resources will be sufficient for us and the next generation, since the world's ecosystems are already under great stress and the society needs to adopt a strategy which will bring improvement in living conditions without global disaster.

## RECOMMENDATIONS

Local action on climate change in regard to building should be taken in the sense of massive public awareness.

Improve knowledge base for effective information management among stake holders in the building industry as well as creating a behavioural awareness on the issue of energy conservation.

Curriculum on sustainability should be included in our schools of environmental studies.

Legislative laws should be in place, both at local and National levels on Green building guidelines.

A ministry on green technology should be created in order to fill the gap on the issue of sustainability and scale up level of adaptability.

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# FACTORS AFFECTING THE CHOICE OF DISPUTE RESOLUTION TECHNIQUES IN THE NIGERIAN CONSTRUCTION INDUSTRY

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Choosing an appropriate dispute resolution technique is crucial to speedy and mutually acceptable resolution of disputes. Many factors contribute to the choice of an appropriate technique, depending on the parties involved in the dispute. This paper reports a study that identified thirty-two factors that may affect the choice of an appropriate Dispute Resolution (DR) Technique that can be applied in a construction operation in North central part of Nigeria. A questionnaire survey was conducted to obtain data in respect of the perception of respondents on how the factors affect their choice of DR Technique. Analysis of the data using the Statistical Packages for Social Sciences (SPSS) showed that Mediation and Conciliation are most affected by 'preservation of relationships', Arbitration is chosen for reasons of fulfilling 'contract obligations', power to enforce decisions' is what influences the choice of Litigation, Minitrial is chosen for its semi-formality, Negotiation is chosen when parties to a dispute are willing while 'bindingness of the decision' had the highest rank in influencing the choice of Dispute Review Boards. 'Bindingness of the decision' was found to be the most crucial factor influencing the choice of DR technique. Contractors find 'confidentiality of the process', 'formality of the process', and 'finality of the process' crucial. Consultants rank 'bindingness of the decision', 'enforceability of the decision', and 'expertise in construction of those involved in the process' very high.

Keywords: dispute resolution, Alternative Dispute Resolution, Nigeria.

## BACKGROUND

Disputes are inevitable in all human relationships, whether business or personal. They often arise when parties to a contract fail to agree on the interpretation and implementation of contractual clauses. Several authors (Aniekwu and Okpala, 1987, 1988; Aniekwu, 1995; Adams, 1997; Ogunsemi and Aje, 2006; Ajanlekoko, 2008 and Dike, 2008) have identified disputes as one of the major setbacks in the Nigerian construction industry. Consequently, resolving disputes has become an inevitable part of Project delivery in today's complex and highly competitive construction industry.

Various dispute resolution techniques (DR) have evolved over the years. These include litigation, arbitration, mediation, negotiation, adjudication and others. Litigation and arbitration have been well developed for the resolution of disputes in the construction industry (Cheung, 1999). However, the lengthy processes and high costs involved have necessitated the search for other alternatives. These other alternatives are termed Alternative Dispute Resolution (ADR) techniques and have become popular because of their flexibility, speed and cost effectiveness. While ADRs

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generally offer some advantage, selecting an appropriate technique presents a challenge. This is because the choice is influenced by a wide variety of activities ranging from the selection of a dispute resolution technique to the actual participation in the negotiation process (Cheung, 1999). The focus of this paper is on the selection of the dispute resolution technique with emphases on the factors that influence the selection.

In deciding what dispute resolution strategy to adopt there is a need to take into consideration some factors that inform the appropriateness of the strategy. From literature, several researchers have identified the various factors that influence the choice of dispute resolution techniques (See Table 1). Many researchers have been able to identify factors critical to the choice of ADRs. These factors are in different forms ranging from how they affect relationships, economy, social status, human issues and procedures. Thus a clear understanding of the relationship between these factors and DRs is an invaluable asset.

Table 1: Factors affecting the choice of ADR Techniques

Factor	Meaning	Source
1. Confidentiality of the process	Parties to the dispute are not allowed to disclose any information or materials to the public. Settlements are made without disclosure and violation of the dispute.	Cheung (1999)
2. Degree of control by parties	Parties to a dispute have greater control over the outcome and content of the proceedings.	Holland and Thomas (1999)
3. Flexibility of the process	Settlements have to comply with time and future changes.	Chen (2002)
4. Choosing format	The ability of the format to choose between and legislative suggestions.	Holland and Thomas (1999)
5. Binding decision	The nature of the dispute.	Cheung et al (1999)
6. Type of dispute (dispute lines)	A 'win-win' settlement is always obtained by the neutral parties remain friendly to each other.	Cheung (1999)
7. Preservation of relationships	Parties should be treated in dispute application and non-disputary cases.	Cheung (1999)
8. Speed of the process	Parties agree to engage in the process almost instant.	Han (2002)
9. Voluntary	Consent to the process.	Cheung (1999)
10. Feasibility of the process	Efficient in the process of problem solving.	Ajzenbalt (2002)
11. Efficiency in management	A less complex and more efficient way.	Yin and Lee (2000)
12. Improves communication	Parties agree to understand mutual interests.	Cheung (1999)
13. Willingness of the parties involved	Disputing parties should be ready to negotiate and agree to a deal.	Cheung (1999)
14. Reliability of the decision	A reliable and impartial party management is always to be given by the parties.	Cheung (1999)
15. Endlessness of the decision	A 'win-win' settlement that is to be made without agreement among parties.	Holland and Thomas (1999)
16. Addressing Target Issues	The choice of ADR may be influenced by the situation involved in the dispute.	Cheung (1999)
17. Effectiveness of the process	How the parties need to demonstrate an ability to resolve the dispute.	Cheung (1999)
18. Voluntary consent to the dispute	Expressing willingness to resolve the dispute and personal relationships.	Holland and Thomas (1999)
19. Dispute in the context of the dispute	Ability to make an oral or written agreement to the dispute.	Han (2002)
20. Leads to a final agreement	The process should be a final and binding agreement.	Chen (2002)
21. Current Position Between the parties	A court should be used to adequately address the dispute.	Cheung et al (1999)
22. Most Disputes are Resolvable	Whether or not ADR is a part of the contract.	Ajzenbalt (2002)
23. Final Settlements Outcome	The final outcome of the dispute resolution of the dispute.	Cheung (1999)
24. Control Disputes	Ability of the process to ensure parties to make an agreement.	Cheung (1999)
25. Control of the process	Whether or not the Regulation of the Government is applied to the ADR.	Cheung (1999)
26. Power to Control Disputes	A court should be used to adequately address the dispute.	Chen (2002)
27. Government Regulation	A court should be used to adequately address the dispute.	Chen (2002)
28. Relationship with the process	Whether or not the Regulation of the Government is applied to the ADR.	Cheung (1999)
29. Power of the process	Control of the process is applied to the dispute.	Ajzenbalt (2002)
30. The nature of the dispute	Control of the process is applied to the dispute.	Chen (2002)
31. Ability to agree	Control of the process is applied to the dispute.	Chen (2002)
32. Control of the process	Control of the process is applied to the dispute.	Chen (2002)

It is worth noting that these researchers only focused on the identification of the factors. Nothing seems to exist on the assessment of the influence of these factors in the choice of individual dispute resolution technique. However, some related work exists.

## RELATED STUDIES

Cheung (1999) discussed the philosophies behind ADRs and evaluated 12 critical attributes of ADR techniques with the use of scale rating and percentage rating. He narrowed the 12 attributes to five factors by the use of factor analysis. The author concluded that users of ADR are pragmatic and consider obtaining benefits (such as speedy resolution and preservation of relationships) as the most critical factor affecting the use of ADR in the construction industry in Hong Kong. However, the study did not evaluate the factors for individual dispute resolution techniques.

In a later study, Cheung et al (2002) expanded the factors to 19 and developed a hierarchical model that prioritized the factors influencing the choice of ADR processes. The study concluded that the top-ranked attributes include preservation of relationships, enforceability, neutrality and consensus. Although such a prioritisation is useful it does not provide a framework for the selection of an appropriate technique. Recognising this, Cheung and Suen (2002) and Chan et al (2006) enhanced the prioritisation by developing a decision-making model using the analytical hierarchy process (AHP) and multi-attribute utility technique to aid the selection of an appropriate technique. Notice though that the empirical data was based on the perception of experts in Hong Kong.

In summary, several factors that influence the choice of an appropriate dispute resolution technique have been reported. These have been prioritised and employed to develop models to aid the selection process. However, nothing seems to exist on the influence of these factors on the choice of appropriate dispute resolution techniques in Nigeria. This paper seeks to fill this gap. It presents preliminary results of an ongoing work aimed at assessing the influence of the factors in the choice of seven dispute resolution techniques. This will be invaluable to stakeholders in selecting an appropriate dispute resolution technique.

It is worth noting that researches are available on the wider area of DR and ADR techniques which are closely related to, but not exactly focused on the theme of this paper. Authors like Harmon (2003), Chan and Suen (2005), Yiu and Lai (2009) and Pulket and Arditi (2009) discussed dispute resolution techniques and alternative dispute resolution techniques extensively.

## RESEARCH METHOD

This research adopted a quantitative approach. The review of literature conducted revealed seven (7) DR techniques and thirty-two (32) factors that affect the choice of DR techniques. A questionnaire survey of contractors (building and civil engineering), consultants (architects, engineers and quantity surveyors) and construction clients/client's representatives was carried out across the six geo-political zones in Nigeria. However, this paper considers the survey results obtained from the respondents in the North Central part of Nigeria. The questionnaire consist of two sections; part A captures general and demographic information about the respondents and the organisations they work for while part B elicits information on the respondents' perception of the level of importance of the identified factors on the choice of a DR technique using a five-point Likert-type scale. The scale ranges from 0 to 4 where 0 = "very unimportant", 1 = "unimportant", 2 = "somewhat important", 3 = "important" and 4 = "very important".

The questionnaires were either posted or hand delivered to a carefully selected sample of 100 respondents in each geo-political zone. A total of twenty-nine (representing

29%) questionnaires were successfully retrieved from the North-Central Zone and subsequently used for the analysis. Descriptive and inferential analyses were conducted using the Statistical Packages for Social Sciences (SPSS). The weighted mean scores were used as the basis for ranking the respondent's perception of the level of importance of the identified factors on the choice of DR technique; Standard deviations of the response data were calculated to assess the consistency amongst the survey respondents; and 2-tail t-tests were used to evaluate the level of agreement/disagreement between the consultant and contractor sub-groups.

## INTERIM RESULTS/DISCUSSIONS

The findings of the study are presented and discussed in this section.

The composition of the respondents by years of experience, nationality and role in the construction industry is shown in Table 2.

Table 2: Profile of Respondens

a. Years of experience of respondents		
	Frequency	Percent
Less Than 5 Years	2	6.9
5 - 10 Years	7	24.1
10 - 15 Years	4	13.8
Over 15 Years	16	55.2
Total	29	100.0
b. Nationality of respondents' organisation		
	Frequency	Percent
Domestic	24	82.8
Joint Venture	1	3.4
Foreign	4	13.8
Total	29	100.0
c. Role of respondents in Construction		
	Frequency	Percent
Contractor	12	41.4
Consultant	16	55.2
Owner/Owner's representative	1	3.4
Total	29	100.0

Over 50% of the respondents had experiences above 15 years in construction. 82.8% were domestic (operate in Nigeria and are Nigerians), while 13.8% were Foreigners (non-Nigerians operating in the country). **Error! Not a valid bookmark self-reference.** shows a summary of total number of times respondents participated in the various forms of ADRs

Table 3: Number of Times Respondents Participated in various Dispute Resolution Techniques

S/N	TECHNIQUE	FREQUENCY
1	Conciliation	229
2	Mediation	204
3	Arbitration	33
4	Litigation	65
5	Mini-Trial	52
6	Negotiation	530
7	Dispute Review Board	54

8	Adjudication	1
	TOTAL	1,168

Adjudication accounted for only 1 out of 1,168 (less than 1 %). Thus Adjudication was not considered in the analysis. Adjudication was reported to be the commonest form of ADR in Nigeria by Oladapo and Onabanjo (2009). On the contrary, finding of this study shows a very negligible use of Adjudication (table 3). This difference may be connected to fact that Oladapo and Onabanjo (2009) carried out their studies the south-western part of the country while this report focused on the north-central part. The two regions have contrasting socio-economic values.

The means, standard deviations and rankings of the responses for all the factors on and how they affect the choice of the various techniques are presented on appendix A. Table 4 shows the five most influencing factors for the choice of various DR techniques.

Table 4: Top five factors influencing the choice of various DR techniques

Rank	Conciliation	Mediation	Arbitration	Litigation	Mini Trial	Negotiation	DRB
1	Preservation of Relationships	Preservation of Relationships	Contract Obligations	Enforceability of the Decision	Formality of the Process	Willingness of the Parties Involved	Bindingness of Decision
2	Control by parties	Improves Communication	Expertise in Construction	Finality of the Process	Finality of the Process	Addressing Range of Issues	Addressing Range of Issues
3	Willingness of the Parties Involved	Leads to Creative Agreement	Obtaining Fairness	Bindingness of Decision	Enforceability of the Decision	Obtaining Fairness	Obtaining Fairness
4	Speed of the Process	Control by parties	Bindingness of Decision	Government Regulations	Government Regulations	Preservation of Relationships	Enforceability of the Decision
5	Confidentiality of Process	Willingness of the Parties Involved	Government Regulations	Ability to Appeal	Bindingness of Decision	Improves Communication	Expertise in Construction

Table 4 reveals ‘Bindingness of the decision’ as the most crucial factor influencing choice of an appropriate technique in the north-central part of Nigeria, having appeared amongst the top five factors in selecting four DR techniques. The other critical factors that influences the choice of appropriate DR techniques includes preservation of relationship, control of the process, willingness of the parties involved, obtaining fairness, government regulations, enforceability of decisions, expertise in construction and improvement of communication.

The results also suggest that for Conciliation and Mediation, ‘Preservation of Relationships’ was most influential, agreeing with York’s (1996) assertion that the factor is crucial. The choice of Arbitration was most affected by ‘Contract Obligations’. This may not be far from the fact that Arbitration is embedded in the conditions of most construction contracts. Arbitration is also highly technical. Participation in arbitration is less than in any other ADR (table 3) contrary to the practice in China and Hong Kong (Chan and Suen, 2005; Cheung, 1999). Arbitration is most preferred in china. Inferentially ‘Contract Obligations’ is the least concern of the factors to construction participants in north central Nigeria. Far East Asians are known for their ‘saving face’ culture which Arbitration provides. ‘Power to Enforce Decisions’ was more important in the choice of Litigation. Litigation is still popular in Nigeria (Oladapo and Onabanjo, 2009) mostly because of its enforceability. The publicity associated with litigation is a major setback to its choice even though some disputes can only go to litigation for reasons of establishing social norms and legal

precedence (Cheung, 1999). Formality of Mini Trial ranked highest. Brown and Marriot (1999), Cheung (1999) observed that formality or otherwise of a technique has a bearing on its choice as an ADR. Minitrials are semiformal in nature. The choice of Negotiation was influenced most by 'Willingness of the Parties involved'. It is important to note that negotiation is practiced more than all the other methods (table 3). This agrees with Cheung and Suen (2002) who reported that 70% of construction disputes are settled through negotiation. Consequently it can be inferred that 'Willingness of the Parties involved' is the most crucial factor considered for choosing an ADR by the respondents. Negotiation is perhaps the best form of ADR as no cost is incurred. Cheung (1999) ranked preservation of relationships 3rd among the 12 attributes he studied. For Dispute Review Board (DRB), 'Bindingness of the Decision' was most critical.

A 2-tail t-test showing the significant difference between the groups at 95% confidence interval is shown on appendix B. Contractors and Consultants significantly differed in their opinions on some factors when choosing an appropriate dispute resolution technique. Contractors believed that 'confidentiality of the process', 'formality of the process' and 'finality of the process' are more crucial. While Consultants hold 'bindingness of the decision', 'enforceability of the decision', 'type of dispute (major /minor)', 'expertise of those involved', 'preservation of relationships', 'ability to appeal', 'leads to creative agreement', 'risk associated with the process', 'power to compel consolidation' and whether the process 'leads to effective case management' more crucial.

It is important to note that only 4 of the respondents are foreigners. The responses from foreigners were found to be inadequate to draw any conclusion as such the concluding part of the survey will attempt to address the issue. The concluding survey will also gather information from the other three geopolitical zones and conclude on how the factors affect the choice of DR techniques in the country (i.e. Nigeria)

## **CONCLUSIONS**

Choosing the most effective method to resolve dispute in construction works is very crucial to the speed and success of any construction contract. Prompt and effective settlement of disputes- one of the major causes of poor performance of the construction industry in Nigeria, will improve performance in no small measure. This study examined the factors that influence the choice of dispute resolution techniques in the Nigerian construction industry. The results show that the factors commonly responsible for the choice of an appropriate technique depend on the technique and the group making the choice (Contractors, Consultants or Foreigners). Mediation and Conciliation are most affected by 'preservation of relationships', Arbitration is chosen for reasons of fulfilling 'contract obligations', 'power to enforce decisions' is what influences the choice of Litigation, Minitrial is chosen for its semi-formality, Negotiation is chosen when parties to a dispute are willing while 'bindingness of the decision' had the highest rank in influencing the choice of Dispute Review Boards. 'Bindingness of the decision' is the most crucial factor influencing the choice of an appropriate dispute resolution technique in the north-central part of Nigeria.

Apparently, Contractors find 'confidentiality of the process', 'formality of the process' and 'finality of the process' crucial. Consultants rank 'bindingness of the decision', 'enforceability of the decision', and 'expertise in construction of those involved in the processes very high.



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## APPENDICES

Appendix A: Mean and Ranking for factors influencing Choice of ADR technique

SN	FACTORS	Conciliation			Mediation			Arbitration			Litigation			Mini Trial			Negotiation			DRB		
		M	SD	R	M	SD	R	M	SD	R	M	SD	R	M	SD	R	M	SD	R	M	SD	R
1	Preservation of Relationships	3.84	0.47	1	3.65	0.37	1	2.84	0.89	23	2.00	1.41	31	2.00	1.30	30	3.55	0.74	4	2.79	1.05	9
2	Control of the Process	3.77	0.43	2	3.40	0.91	4	2.89	1.20	22	2.78	1.30	19	2.50	1.09	19	3.48	0.60	6	2.21	1.05	30
3	Willingness of the Parties	3.61	0.78	3	3.39	0.94	5	3.16	1.12	11	2.92	1.51	16	2.64	1.39	17	3.65	0.49	1	2.57	1.22	20
4	Speed of the Process	3.60	0.71	4	3.32	0.95	8	3.14	1.01	13	2.50	1.51	23	2.33	1.30	24	3.41	0.67	9	2.64	1.01	14
5	Confidentiality	3.42	0.72	5	3.04	0.92	13	2.68	1.20	26	2.09	1.30	30	1.93	1.21	31	3.17	0.98	15	2.64	1.03	16
6	Improves Communication	3.39	0.89	6	3.56	0.71	2	2.90	0.97	21	2.45	1.37	25	2.38	1.45	21	3.52	0.60	5	3.00	0.88	6
7	Flexibility of the Process	3.36	0.66	7	3.19	0.85	11	2.90	1.07	20	2.17	1.27	29	2.21	1.12	26	3.09	0.97	19	2.29	0.61	28
8	High Likelihood of Consensus Agreement	3.36	0.76	8	3.19	0.94	10	2.80	1.06	24	2.82	1.25	17	2.13	1.25	29	3.19	0.75	14	2.73	0.88	11
9	Creative Agreement	3.27	0.94	9	3.42	0.78	3	2.68	1.25	25	2.27	1.42	28	2.14	1.17	28	3.48	0.81	7	2.69	1.03	13
10	Obtaining Fairness	3.22	0.90	10	3.35	0.83	7	3.44	0.78	3	3.00	1.31	14	2.80	1.37	12	3.58	0.84	3	3.08	1.08	3
11	Expertise	3.20	0.96	11	3.25	0.90	9	3.48	0.78	2	2.64	1.28	21	2.38	1.26	22	3.52	0.79	10	3.07	0.88	5
12	Final Settlement	3.19	0.98	12	3.00	0.98	14	3.11	0.68	14	3.29	1.05	9	3.20	0.94	7	2.73	1.16	26	2.62	1.04	17
13	Privacy of the Process	3.13	0.97	13	2.75	1.03	20	2.39	0.78	31	1.89	0.93	32	1.79	0.89	32	3.00	1.05	22	2.50	0.85	23
14	The Range of Remedies	3.11	0.88	14	3.36	0.90	6	2.61	1.09	28	2.18	1.40	28	2.20	1.32	27	3.42	0.89	8	2.50	1.00	24
15	Voluntary Process	3.10	0.85	15	2.94	0.87	15	2.47	1.06	30	2.25	1.39	27	2.27	1.27	28	3.24	0.83	13	2.18	1.08	31
16	Bindingness of Decision	3.08	0.93	16	2.83	0.82	16	3.42	0.72	4	3.61	0.70	3	3.35	0.70	5	3.29	0.96	12	3.25	0.75	1
17	Ability to Appeal	3.06	1.14	17	2.77	1.27	19	3.10	0.91	15	3.56	0.89	5	3.35	0.70	6	2.59	1.00	28	2.93	1.07	7
18	Meet Budget and Schedule	3.05	1.18	18	2.89	1.23	16	2.56	1.26	29	2.45	1.37	24	2.54	1.45	18	2.95	1.18	23	2.55	1.13	21
19	Addressing Range of Issues	3.00	1.10	19	3.08	0.95	12	3.19	0.81	9	3.13	1.13	11	2.75	1.06	15	3.59	0.73	2	3.15	0.69	2
20	Effective Case Management	2.90	1.14	20	2.67	1.24	24	3.21	0.71	8	3.13	0.81	12	3.00	0.85	9	3.11	0.96	17	2.73	0.95	10
21	Enforceability	2.88	0.94	21	2.87	1.01	17	3.29	1.01	7	3.89	0.32	1	3.41	0.80	3	3.14	0.99	16	3.08	0.95	4
22	Type of Dispute	2.85	1.18	22	2.56	1.07	26	2.67	1.06	27	3.13	0.92	10	2.75	1.13	14	3.32	0.89	11	2.58	0.90	19
23	Monetary Amount Involved	2.81	0.98	23	2.74	0.93	22	3.00	0.97	16	2.81	1.38	18	2.88	1.17	11	3.06	0.80	21	2.54	0.97	22
24	Contract Obligations	2.81	1.08	24	2.74	1.10	21	3.50	0.89	1	3.38	1.02	8	3.13	0.99	8	3.11	0.88	18	2.64	1.15	15
25	Liability to Opponent's Cost for Process	2.56	1.26	25	2.50	1.29	27	2.94	0.83	19	2.92	1.04	15	2.73	1.10	16	2.56	1.15	30	2.71	1.07	12
26	Current Hostility	2.50	1.42	26	2.43	1.25	28	2.94	1.16	18	3.07	1.16	13	2.38	1.20	23	2.75	1.18	25	2.45	1.04	27
27	Formality of the Process	2.50	1.19	27	2.67	1.11	23	3.19	0.87	10	3.53	0.72	6	3.47	0.83	1	2.59	1.23	29	2.46	0.78	26
28	Cost of the Process	2.50	1.32	28	2.39	1.27	29	2.95	1.00	17	2.73	1.33	20	2.75	1.24	15	3.08	1.11	20	2.80	0.91	18
29	Finality of the Process	2.43	1.08	29	2.64	1.14	25	3.14	0.79	12	3.79	0.42	2	3.41	0.82	2	2.89	0.99	24	2.50	0.65	25
30	Power to Compel Consolidation	2.41	1.12	30	2.29	1.16	30	3.37	0.93	6	3.38	0.89	7	3.00	0.93	10	2.60	1.24	27	2.57	1.22	20
31	Government Regulations	2.36	1.55	31	2.17	1.42	31	3.37	0.83	5	3.59	0.80	4	3.38	0.81	4	2.46	1.39	32	2.93	1.07	7
32	Risk Associated with the Process	2.00	1.03	32	2.10	1.09	32	2.28	1.23	32	2.53	1.28	22	2.41	1.06	20	2.50	1.10	31	2.07	1.14	32

Appendix B: Group Statistics for contractors'/consultants' opinion on Factors affecting Choice of ADR technique

Appendix B: Group 1 ratings for contractors' (non-claimants') opinion on Factors affecting Choice of ADR technique																						
	Role	Conciliation			Mediation			Arbitration			Litigation			Mini Trial			Negotiation			DRB		
		M	SD	R	M	SD	R	M	SD	R	M	SD	R	M	SD	R	M	SD	R	M	SD	R
Confidentiality	Contr	3.80	0.42		3.30	0.87		2.78	1.09		2.25	1.29		2.50	0.98		3.40	0.64		2.58	1.08	
	Const	3.15	0.80	0.28	2.88	1.02	0.76	2.60	1.35	0.78	2.00	1.41	0.29	2.25	1.49	0.29	3.00	1.13	0.88	2.80	1.10	
Bindingness	Contr	3.36	0.87		3.10	0.57		3.09	0.83		3.33	0.87		3.00	0.76		3.50	0.85		3.40	0.85	
	Const	2.75	1.06	0.18	3.33	0.89	0.04	2.69	0.45	0.09	3.89	0.32	0.06	3.67	0.50	0.26	3.00	0.95	0.59	3.14	0.90	
Enforceability	Contr	3.00	0.71		3.33	0.87		2.67	1.12		3.78	0.44		3.13	0.99		3.27	1.01		2.83	0.98	
	Const	2.67	1.07	0.08	2.67	1.02	0.01	3.75	0.82	0.13	4.00	0.00	0.17	3.67	0.50	0.41	2.80	0.99	0.42	3.29	0.95	
Obtaining Fairness	Contr	3.11	1.05	0.91	3.38	0.74	0.75	3.38	0.52	1.00	3.00	1.26	0.51	2.50	1.38	0.89	3.71	0.76	0.77	3.20	0.84	
	Const	3.21	0.85		3.33	0.90		3.80	0.97		3.00	1.41		3.00	1.41		3.55	0.93		3.00	1.29	
Addressing Range of Issues	Contr	2.82	1.25		2.80	0.93		2.80	0.63		3.17	0.98		2.43	0.73		3.70	0.48		3.17	0.75	
	Const	3.08	1.00	0.45	3.20	0.94	0.96	3.18	0.98	0.93	3.11	1.27	0.30	3.00	1.20	0.47	3.45	0.93	0.95	3.14	0.69	
Voluntary Process	Contr	3.00	0.87		2.71	0.78		2.00	0.89		3.00	1.00		2.33	1.21		3.25	0.89		2.00	0.89	
	Const	3.20	0.92	0.39	3.09	0.94	0.17	2.78	1.09	0.27	1.80	1.48	0.87	2.20	1.48	1.00	3.25	0.89	0.57	2.40	1.34	
Improves Communication	Contr	3.45	0.82		3.80	0.42		2.90	0.88		2.80	1.10		2.67	1.27		3.40	0.92		3.00	0.78	
	Const	3.33	0.86	0.17	3.40	0.83	1.00	2.90	1.10	0.47	2.17	1.50	0.54	2.14	1.57	0.38	3.64	0.67	1.00	3.00	1.10	
Leads to Creative Agreement	Contr	3.09	0.84		3.20	0.82		2.60	1.35		2.20	1.30		2.14	1.07		3.00	0.94		2.71	0.95	
	Const	3.45	0.93	0.55	3.50	0.78	0.77	2.78	1.20	0.89	2.33	1.83	1.00	2.14	1.35	0.01	3.81	0.80	0.94	2.67	1.21	
The Range eddies	Contr	3.00	0.82		3.40	0.97		2.67	0.71		1.40	0.55		1.80	0.84		3.20	0.79		2.29	0.78	
	Const	3.22	0.97	0.87	3.33	0.99	0.84	2.58	1.42	0.09	2.83	1.60	0.37	2.50	1.67	0.15	3.67	0.80	0.41	2.60	1.30	
Monetary Amount Involved	Contr	3.00	0.77		3.13	0.84		3.00	0.71		2.38	1.30		2.63	0.92		2.89	0.78		2.50	0.58	
	Const	2.80	1.17	0.13	2.45	1.04	1.00	3.00	1.18	0.21	3.25	1.39	0.41	3.11	1.38	0.39	3.22	0.83	0.90	2.67	1.27	
Type of Dispute	Contr	2.82	1.17	0.62	2.44	1.01	0.79	2.73	1.01	0.10	2.71	0.95	0.02	2.13	1.13	0.45	3.44	0.88	0.36	2.33	0.82	
	Const	2.75	1.28		2.70	1.16		2.80	1.17		3.50	0.76		3.38	0.74		3.11	0.93		3.33	0.98	
Cost of the Process	Contr	2.80	1.35		2.20	1.40		2.90	0.74		2.38	1.47		2.80	1.07		2.75	1.48		2.39	0.92	
	Const	2.50	1.35	0.84	2.64	1.20	0.82	3.00	1.21	0.28	3.14	1.57	0.44	3.00	1.41	0.31	3.30	0.67	0.32	2.88	0.90	
Speed	Contr	3.84	0.67	0.61	3.20	1.23	0.88	3.18	0.75	0.86	2.20	1.30	0.07	1.87	0.82	0.90	3.40	0.84	0.20	2.29	0.78	
	Const	3.54	0.78		3.40	0.74		3.10	1.29		2.80	1.79		3.00	1.85		3.38	0.50		3.00	1.15	
Flexibility	Contr	3.40	0.70		3.00	1.10		2.80	0.88		2.40	1.14		2.67	1.27		3.40	0.92		3.00	0.78	
	Const	3.33	0.68	0.33	3.33	0.62	1.00	2.90	1.29	0.61	2.00	1.41	0.90	2.43	1.27	0.21	3.33	0.78	0.27	2.50	0.55	
Formality of the Process	Contr	2.90	0.88	0.24	3.00	1.12	0.01	2.70	0.98	0.24	3.33	0.87	0.48	3.29	1.11	0.52	2.78	1.09	0.11	2.14	0.38	
	Const	2.70	1.37	0.24	2.42	1.03	0.79	3.54	0.50	0.75	4.46	0.46	0.63	3.55	0.51	0.25	2.88	1.41	0.22	2.33	0.99	
The Parties' Ability to Control	Contr	3.60	0.52		3.30	0.80		3.00	0.88		3.00	1.00		2.80	0.92		3.33	0.67		3.00	0.77	
	Const	3.32	0.93	0.02	3.73	0.48	0.47	3.11	1.48	0.87	2.83	1.47	0.24	2.88	1.38	0.21	3.64	0.50	0.47	2.43	1.41	
Preservation Relationships	Contr	3.91	0.30	0.62	3.30	0.42	0.84	2.90	0.88	1.00	2.00	1.00	0.86	1.07	0.00	0.00	3.20	0.92	0.53	2.63	0.90	
	Const	3.35	0.55		3.88	0.34	0.84	2.78	1.84	1.00	2.00	1.67	0.74	1.14	1.57	0.00	3.81	0.30	0.53	3.00	1.20	
Privacy	Contr	3.09	0.84		3.20	0.82		2.60	1.35		2.20	1.30		2.14	1.07		3.00	0.94		2.71	0.95	
	Const	3.45	0.93	0.77	3.67	1.00	0.13	3.11	0.80	0.72	1.78	0.80	0.18	1.70	0.93	1.00	3.00	1.10	0.22	2.25	0.77	
Consensus Agreement	Contr	3.00	0.77		3.13	0.84		3.00	0.71		2.38	1.30		2.63	0.92		2.89	0.78		2.50	0.58	
	Const	2.80	1.17	0.13	2.45	1.04	1.00	3.00	1.18	0.21	3.25	1.39	0.41	3.11	1.38	0.39	3.22	0.83	0.90	2.67	1.27	
Expertise	Contr	3.30	1.10		3.10	1.10		3.30	1.15		2.71	1.38		2.57	1.27		3.27	0.78	0.63	2.88	1.07	
	Const	3.25	0.97	0.50	3.10	1.10	0.39	3.30	1.15	0.24	2.71	0.98	0.04	2.75	0.71	0.34	3.20	0.92	0.38	2.88	0.84	
Finality of the Process	Contr	2.67	1.08		2.78	1.30		2.82	0.87		3.78	0.44		3.13	0.84		3.27	1.08		2.80	1.05	
	Const	2.18	1.55	0.64	2.54	1.05	0.05	3.50	0.53	0.91	3.80	0.42	0.07	3.67	0.50	0.36	3.67	1.12	0.10	2.50	0.50	
Risk Associated	Contr	1.60	0.97	0.86	2.11	1.17	0.38	2.00	1.00	0.31	2.22	1.20	0.23	2.11	1.78	0.03	1.88	1.07	0.80	2.17	1.33	
	Const	2.40	0.97		2.08	1.08		2.98	1.42		1.88	1.28		2.75	1.28		3.00	0.87		2.10	1.37	
Power to Compel Consolidation	Contr	2.74	1.14		2.80	1.00		3.00	1.07		2.75	0.98		2.75	0.98		3.00	1.07		2.75	1.08	
	Const	2.44	1.42	0.88	2.30	1.42	0.15	3.67	0.71	0.27	3.83	0.52	0.02	3.50	0.53	0.63	2.75	1.28	0.28	2.67	1.55	
Government Regulations	Contr	2.44	1.33	0.59	2.00	1.15	0.14	3.10	0.88	0.45	3.43	0.61	0.23	3.13	0.83	0.91	2.80	1.20	0.24	2.63	1.19	
	Const	2.20	2.05	0.28	3.38	1.77	0.14	3.67	0.71	0.45	3.75	0.46	0.23	3.63	0.74	0.44	2.40	1.82	0.24	3.33	0.83	
Willingness of the Parties to Involve	Contr	3.45	0.54	0.02	2.80	1.20	0.53	3.00	0.84	0.36	2.80	1.38	0.11	3.13	0.99	0.43	3.80	0.52	0.51	3.38	0.93	
	Const	3.20	0.85		2.80	1.20		3.00	0.84		2.80	1.38		2.80	1.38		3.00	0.84		2.80	1.20	



# HOW AND TO WHAT EXTENT DO CONSTRUCTION PROJECT FEATURES CONTRIBUTE TO ACCIDENT CAUSATION? AN INSIGHT FOR ACCIDENT PREVENTION

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The implementation of effective accident prevention measures requires insight into how accidents occur and the extent to which accident causal factors contribute to accidents. Construction projects features (CPFs) such as the nature of project, method of construction, site restriction, project duration, procurement system, design complexity, level of construction, and subcontracting have been noted as being contributors to accident causation. However, how they contribute to accident causation and the extent of their contribution remain to be fully explored by research. An extensive review of health and safety (H&S) literature within the UK construction industry discusses the accident causal influence of CPFs to the end of providing preliminary insight into how and the extent to which CPFs contribute to accident causation. The study reveals that CPFs contribute to accident causation through the introduction of proximal accident causal factors and the extent of their contribution is influenced by the degree of prevalence of the proximal factors within the CPFs. The usefulness of this insight for preventing accidents right from the early stage of project procurement is subsequently presented. The application of the findings of the study will contribute towards achieving improved health and safety outcomes on construction projects.

Keywords: accident, distal causal factor, health and safety, proximal causal factor.

## INTRODUCTION

The implementation of effective accident prevention measures requires knowledge of accident causal factors, how the causal factors contribute to accidents and the extent of their contribution (Suraji et al., 2001). Despite the considerable evidence underscoring the contribution of CPFs to accident causation, knowledge of how they contribute to accident causation and the extent of their contribution to accident causation remain unknown. This study through an extensive review of H&S literature within the UK construction industry interrogates these grey areas in H&S to provide preliminary

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insight into how and the extent to which CPFs such as the nature of project, method of construction, site restriction, project duration, procurement system, design complexity, level of construction, and subcontracting contribute to accident causation. The insight having been provided, the study subsequently puts forth the benefits it offers in relation to accident prevention from the early stage of project procurement.

## **EXPLORING THE ACCIDENT CAUSAL INFLUENCE OF CPFs**

CPFs can be defined as organisational, operational, and physical attributes that characterise construction projects and like other originating influences in construction accidents, these CPFs are high level determinates of the nature, extent and existence of immediate causes of accidents (Haslam et al., 2005). The subsequent section of this study discusses the contribution of CPFs to accident causation towards developing an understanding of the process of their contribution as well as the extent of their contribution to accident causation.

### **Nature of project**

The nature of project (i.e. new work, repair/refurbishment/maintenance and demolition) is usually determined by the client's brief. The UK Office for National Statistic (ONS) (ONS, 2009) indicates that compared to new work, repair and refurbishment work constitute a fairly consistent proportion of approximately 45% of the industry's total output (i.e. total annual value of construction work), which from 2006 to 2009 is averagely £106,546 million/year. The UK Health and Safety Executive (HSE) Construction Intelligence Report (HSE, 2009), however demonstrates that refurbishment and repair work constitutes a fairly consistent proportion of fatal accidents at around 50%. Refurbishment and repair work therefore accounts for a disproportionate percentage of fatal accidents. This trend is attributable to the fact that, the hazards during refurbishment are more uncertain, complex, and hence difficult to observe and evaluate than the hazards on new works (cf. Egbu (1999) and Loughborough University (2006)). Like refurbishment work, demolition work shares similar attributes and is also a hazardous operation responsible for accidents (Hughes and Ferrett, 2008). Hazards such as falling debris, premature collapse of element/structures, dust and fumes, asbestos, noise and vibration, and electric shock are common in demolition and refurbishment work (Loughborough University, 2006; Hughes and Ferrett, 2008), and given that these hazards are *uncertain and complex*, it is only consequential that refurbishment work and demolition work are more dangerous than new work (Loughborough University and Milan Polytechnic, 2004; Loughborough University, 2006).

### **Method of Construction**

Studies have pointed to the contribution of method of construction to accident causation (cf. Gibb (1999, 2001), McKay et al. (2002), Loughborough University and UMIST (2003) and Wright et al. (2003)). This is influenced by *manual handling*, which is involved in over one-third of all construction injuries in the UK (HSE, 2009). Perttula et al. (2003) in a study conducted in Finland, similarly attributed manual handling to a third of the accidents in their study. The traditional/conventional on-site method, compared to pre-assembly construction (off-site fabrication), involves extensive manual handling and therefore introduces a lot of manual handling hazards and thus implying a causal link to accidents involving manual handling. A study by Gibb (2001) reports that because pre-assembly brought the construction site into the factory where the environment is more controllable, safety, productivity and quality

could be improved. The Strategic Forum for Construction (2002), McKay et al. (2002), Loughborough University and UMIST (2003), and Wright et al. (2003) have similarly emphasized the H&S benefits of using pre-assembly construction.

### **Site Restriction**

Compared to an unrestricted site, a restricted site (provided by the client) would imply insufficient storage space and limited or congested working space for the operatives, plants, machines and equipment on site (cf. Loughborough University and UMIST (2003)). A restricted site would thus influence accidents as a result of the *site congestion* it introduces, which has been a persistent cause of accidents (cf. Entec UK Ltd (2000), Loughborough University and UMIST (2003) and Loughborough University (2009)). Congested site conditions would imply insufficient working space, constricted room for vehicle manoeuvrability and difficult access to drop-off points, possibly resulting in the need for double handling of materials, all of which have safety implications (Loughborough University and UMIST, 2003). These antecedents influence accidents such as a worker being struck by a moving vehicle or by a moving (including flying/falling) objects, which are among the main causes of fatalities as demonstrated by the HSE (2009).

### **Project Duration**

During construction, it is possible that the anticipated/targeted construction duration set by the project planners may eventually not be exactly the actual duration spent as there could be time over-runs or early completion. However, this planned duration has the potential to influence accident occurrence. A constrained duration set by the client or the project management team would introduce *time pressure* at the construction phase with subsequent problems such as trade overlap, crowded work space, reduced attention to detail, and the prioritising of production over safety, which influence accident occurrence (Mayhew and Quinlan, 1997; Loughborough University and UMIST, 2003).

### **Design Complexity**

The influence of design on accident causation has been well echoed throughout the UK construction industry (cf. Entec UK Ltd. (2000), Loughborough University and UMIST (2003), Wright et al. (2003) and Donaghy (2009)), hence the existence of the Construction (Design and Management) Regulations 2007. The findings of Loughborough University and UMIST (2003) indicated that an increased desire for aesthetic qualities inhibit *the ease of building*, which in itself induces safety hazards. As part of the research informing the Donaghy Report (2009), Loughborough University (2009) again mentioned poor design for buildability as a causal factor in construction fatalities. Designs that are complex (*having intricate aesthetic qualities*) therefore tend to have a greater potential to influence accident occurrence as such designs inhibit buildability (Loughborough University and UMIST, 2003).

### **Subcontracting**

Several studies within and outside of the UK construction industry have identified subcontracting as a causal factor in construction accidents. In countries such as Spain, Malaysia, Philippines, Poland, China, and Australia, subcontracting has been associated with adverse H&S outcomes in the construction industry (cf. Byrne and van der Meer (2001), ILO (2001) and Yung (2009)). Similarly in the UK, the accident causal influence of subcontracting has been reported over the years (cf. Mayhew and Quinlan (1997), HSL (1999), Loughborough University and UMIST (2003), Ankrh

et al. (2007), Donaghy (2009) and Manu et al. (2009)). Subcontracting could emanate from the pre-construction phase (through decisions by the project planners and client) and/or during the construction phase (by a principal contractor/contractor and client/client representative). Subcontracting inherently *fragments the workforce* thus making it more difficult to manage H&S on site (Mayhew and Quinlan, 1997; Loughborough University and UMIST, 2003).

### **Procurement system**

The UK construction industry is complex covering a large number of players (cf. ONS (2008)). In view of this, Entec UK Ltd (2000) reported that there are organisational obstacles which impede H&S improvement in the industry. Interaction in the supply chain is often divisive rather than supportive and this impedes H&S improvement (ibid). Entec UK Ltd (ibid) however indicated that, partnering is perceived as being able to enhance H&S improvement as it enables the building of close working relationships and it also provides opportunities for discussion, hazard identification and problem solving at the early stages of the project. Another procurement arrangement which is perceived as being able to enhance H&S improvement is design and build (cf. Loughborough University and UMIST (2003)). Loughborough University and UMIST (2003) reported that design and build procurement is perceived as enabling H&S improvement because the contractual arrangements place the responsibility for both design and construction within a single project team, leading to shared goals, improved communication, and a better environment for new ideas to flourish. Evidently these procurement arrangements promote team integration which is essential for project success (Egan, 1998; Strategic Forum for Construction, 2002; Baiden et al., 2006). Contrary to partnering, and design and build procurement, a procurement arrangement that has been identified to have adverse H&S implications is management contracting (HSL, 1999). Management contracting is considered more problematic than the traditional mode of procurement when addressing the maintenance of good H&S (HSL, 1999). Evidently these latter procurement arrangements *fragment the project team* thus impeding effective management of H&S on project.

### **Level of construction**

The level of construction, particularly multi-level/high-level construction involves *working at height*, which accounts for falls from height, which have been responsible for about 50% of fatal injuries from 1996/97 to 2007/08 (HSE, 2009). Thus comparing low-level construction to multi-level/high-level construction, multi-level/high-level construction contributes greater to accident causation. Research by Chua and Goh (2005) in Singapore revealed that underground construction has a higher rate of incidents than above-ground construction. Although Chua and Goh (2005) did not delve deep into the possible causes of the higher rate of incidents associated with underground construction, it is well known that underground construction involves *working in confined space*, which accounts for adverse H&S outcomes (cf. Hughes and Ferrett, 2008) hence the existence of the UK Confined Spaces Regulations 1997.

The above critique of H&S literature clearly demonstrates that the accident causal influence of CPFs is undeniably existent and has severe ramifications. Seeing that effective accident prevention requires an understanding of how accidents occur and the extent to which causal factors contribute to accidents (Suraji et al., 2001) it is essential to investigate these in the context of the accident causal influence of CPFs.



The above review will thus provide a useful point of reference for achieving this insight.

## **UNDERSTANDING THE PROCESS AND THE EXTENT TO WHICH CPFs CONTRIBUTE TO ACCIDENT CAUSATION**

From the above review of the accident causal role of CPFs, it is seen that CPFs do not directly cause accidents but do so through other accident causal factors. These other causal factors which directly lead to accidents are termed proximal causal factors (PFs) (Suraji et al., 2001; Haslam et al., 2005). Proximal factors are closer to accident events than CPFs which are distal to accident events and are therefore also termed distal/root/originating causal factors (Suraji et al., 2001; Haslam et al., 2005). It is by their introduction of the proximal factors that CPFs *contribute* to accident causation. These CPFs also emanate to a large extent from the client's brief, design decisions and project management decisions at the pre-construction stage of project procurement (cf. Suraji et al. (2001), Haslam et al. (2005) and Cheng et al. (2005)).

Construction accidents are multi-causal and the process of causation is very complex (Loughborough University and UMIST, 2003; Behm, 2005; Loughborough University, 2009). Applying this to the accident causal influence of CPFs, it then means that there could be several CPFs contributing to the causation of an accident or accidents. Concerning the accident causal influence of CPFs, H&S literature again indicates that there are causal interactions among CPFs and the proximal factors that are introduced to cause accidents (cf. Wright et al. (2003), Suraji et al. (2001)). These interactions emphasize the multi-causality and the complexity of construction accidents causation (cf. Loughborough University (2009) and Behm (2005)). Taking all these into account, the complex and multi-causal process/pattern by which CPFs contribute to accident causation can be illustrated as shown in Figure 1.

Referring to Figure 1, CPFs are determined by pre-construction decisions by the client, design team and project management team. The CPFs then also introduce proximal causal factors into the construction process at the construction stage, which then give rise to accidents. Concerning the extent to which CPFs contribute to accident causation, the above review also demonstrates that it varies depending on the degree of prevalence of proximal factors within their associated CPFs. This implies that the more common/prevalent a proximal factor is within a CPF the greater the extent to which the CPF contributes to accident causation as illustrated in Table 1. For instance, as shown by Table 1, conventional on-site construction contributes greater to accident causation than pre-assembly construction, as manual handling is more prevalent within conventional on-site construction than pre-assembly construction. Despite indicating the extent of contribution of CPFs to accident causation by a simple qualitative continuum (i.e. from *low* to *high*), Table 1 serves as a useful proxy of the extent to which CPFs contribute to accident causation. It can be argued further that the causal interactions that transpire along the process of causation do mitigate or increase the extent to which CPFs contribute to accident causation by reducing or increasing the prevalence of their related proximal factors (cf. Wright et al. (2003)). As an example of this effect, Wright et al. (ibid) indicate that pre-assembly construction (CPF) can reduce the extent of working at height, and site congestion. This implies that where pre-assembly construction is used with high-level construction (which introduces working at height) and restricted site (which introduces site congestion), pre-assembly construction will not only reduce accidents associated with manual handling, but it will through interaction effect also reduce the prevalence of working

at height and site congestion within high-level construction and restricted site respectively. Through such causal interactions, pre-assembly construction could reduce the extent to which high-level construction and restricted sites contribute to accident causation. The causal interactions also mean that CPFs that emanate from the decisions of a team of project participants can influence the causation of accidents by other CPFs which emanate from the decisions of the same team or another team of project participants, and this exemplifies the inter-causal working relationship that exist among construction project participants (Suraji et al., 2001).

Having shed light on how CPFs contribute to accident causation and the extent of their contribution to accident causation, what then remains is to examine the implications the insight has for efforts towards preventing accidents on construction projects.

## IMPLICATIONS FOR ACCIDENT PREVENTION

The Office of Government Commerce (2004), The Construction (Design and Management) Regulations 2007 (CDM 2007), Entec UK Ltd (2000), Szymberski (1999), Egan (Strategic Forum for Construction, 2002) and others have emphasized the significant influence of pre-construction H&S planning/decision-making on the H&S outcomes of projects. Entec UK Ltd (2000) indicates that the pre-construction stage offers the greatest scope for H&S improvement and Szymberski (1999) reported that the ability of project participants to positively influence H&S is greatest at this stage. Given that CPFs emanate from pre-construction decisions to contribute to accident causation, the understanding of the process of their contribution to accident causation coupled with the extent of their contribution to accident causation therefore represent a useful insight for accident prevention, especially for the project participants whose decisions determine CPFs.

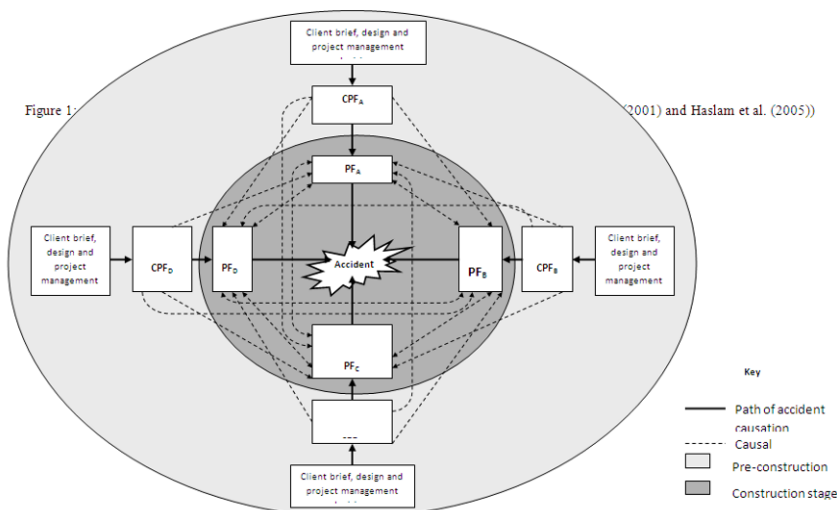



Figure 1: Conceptual model of contribution of CPFs to accident causation (Adapted from Suraji et al. (2001) and Haslam et al. (2005))

Knowing the extent of contribution of CPFs to accident causation (as shown in Table 1), project clients, design teams and project management teams would be equipped to choose CPFs that tend to contribute less to accident causation. However, as mentioned by Suraji et al. (2001) these project participants are often inevitably faced with certain constraints which influences their decisions. This means that the client, design team

and project management teams may be constrained by certain factors to choose CPFs which contribute significantly to accident causation.

Table 1: Extent of contribution of CPFs to accident causation

Proximal Factors	Extent of Contribution of CPF to Accident Causation <i>Prevalence of proximal factor within CPF</i>	
	Low	High 
Uncertainty and complexity of hazards (Egbu, 1999; Loughborough University, 2006)	New work Refurbishment	Demolition
Manual handling (McKay et al., 2002; Wright et al., 2003)	Pre-assembly construction construction	Conventional on-site
Site congestion (Loughborough University and UMIST, 2003; Loughborough University, 2009)	Unrestricted site site	Restricted
Time pressure (Loughborough University and UMIST, 2003; Loughborough University, 2009)	Unconstrained duration duration	Constrained
Fragmentation of project team (HSL, 1999; Matthews and Rowlinson, 1999; Entec UK Ltd, 2000; Loughborough University and UMIST, 2003 )	Design and Build contracting Partnering	Traditional Management
Difficulty in constructing (Loughborough University and UMIST, 2003; Loughborough University, 2009)	Simple Design (Simple aesthetic qualities) qualities)	Complex Design (Intricate aesthetic aesthetic
Working at height / Confined space (Hughes and Ferrett, 2008; HSE, 2009)	Low-level construction construction	Multi/High-level Underground
Fragmentation of work force (Mayhew and Quinlan, 1997; HSL, 1999; Loughborough University and UMIST, 2003)	Single-layer subcontracting subcontracting	Multi-layer

For instance where the requirement for a multi-level facility by a client is imposed on the client organisation by changes in business competitive environment (cf. Suraji et al. (2001)), the design team would similarly be constrained to respond accordingly by designing a multi-level facility. In such constrained situations, the insight of how CPFs contribute to accident causation could be used in devising accident prevention measures. The causal interactions among CPFs and proximal factors could be useful in choosing CPFs that have the potential to reduce the extent to which such inevitable CPFs contribute to accident causation. The causal interactions also means that decisions regarding CPFs should not be made in isolation but consideration should be given to their potential influence on the extent to which other CPFs contribute to accident causation and vice versa.

Apart from the design team and project management team exploiting these causal interactions, other mitigation measures could also be introduced through some aspects of project design and project management right from the pre-construction stage to either eliminate proximal factors or reduce their prevalence within CPFs (cf. Ove Arup and Partners (2007)). It is anticipated that with the collective insight of how CPFs contribute to accident causation and the extent of their contribution to accident causation, construction project participants, especially those engaged at the pre-construction stage, would be able to positively influence the H&S outcomes of projects and by that contribute to H&S improvements in the UK construction industry.

## CONCLUSION

Beyond reporting the contribution of CPFs to accident causation, this study has examined the process by which CPFs contribute to accidents and the extent of their contribution. This collective insight is vital as it is by such insight that effective prevention of construction accidents can be achieved. The study has provided preliminary insight into how CPFs contribute to accident causation and the extent of their contribution to accident causation. Construction project participants from whose decisions CPFs emanate need to take into consideration this insight in order to enable them to positively influence the H&S outcomes of projects from the pre-construction stage of project procurement.

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# HOW DO CLIENTS INFLUENCE INNOVATIONS IN CONSTRUCTION PROFESSIONAL SERVICES FIRMS?

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The pursuit of innovation as means of improving services and achieving competitive advantage in today's rapidly changing business environment has been well documented. Several factors both internal and external to organisations have been identified as influencing innovation. In construction professional services firms, these factors include organisational culture and climate, leadership style and client influence. A number of studies have highlighted the important role internal factors such as leadership style of senior management play in creating a climate conducive to innovation. Others have also recognised the significant influence organisational culture exerts on innovation. Key among the external factors is the client. The role of the client in relation to innovation and project performance has been subject of debate and conjecture. Whereas some writers have projected the client as an enabler of innovation, findings from other studies suggest that they may inhibit it in some circumstances. This paper reviews relevant literature on innovation and critically examines the role of the client in fostering innovation in construction projects. Using three types of innovations, the paper presents the preliminary findings of on-going investigations into the potential influences of internal and external factors on successful implementation of the innovations. The initial findings suggest that clients have both direct and indirect influence on innovation and that their support for innovation is primarily determined by the expected benefits to the client organisation. Specifically, clients can help to create an environment that enables innovation championing behaviour amongst project managers to thrive.

Keywords: client, construction support services, innovation, innovation championing, innovation performance.

## INTRODUCTION

The construction industry has been subjected to criticisms for a while now for non-performance, a common one being that firms often deliver products and services which tend to be below the clients' expectation of quality, price certainty and assured delivery (Lu and Sexton, 2006). This has prompted calls for performance improvement in the industry. Notably, the Office of Government Commerce (OGC, 2007) through the achieving excellence in construction initiative has advocated innovative approaches to delivering construction projects. Innovation has been considered an important means of achieving this improved performance. Within the construction industry, innovation is also being driven by the need for flexibility that enables firms to respond to conflicting expectations and demands from clients in a rapidly changing business environment (Koch and Bendixen, 2005; Kissi et al 2009).

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The concept of innovation has been defined differently by various researchers and stakeholders. It has been considered as ‘the development and implementation of new ideas by people who over time engage in transactions with others within an institutional context’ (Van de Ven, 1986: 604). Slaughter (1998) defined innovation as ‘the actual use of nontrivial change and improvement in a process, product or system that is novel to the institution developing the change’ (Slaughter, 1998: 226). In the construction industry, these improvements could be in the form of enhanced or new approaches to project delivery, new concepts in designs or use of new materials. Thus innovation can be described as the generation or adoption of ideas, design concepts or delivery processes, new to the adopting organisation which when implemented will yield a reduction in cost and/or time associated with project delivery and improve the quality of the final output with an enhanced level of client satisfaction.

A number of variables both internal and external to organisations have been identified by researchers as influencing innovation in construction organisations. The relationship between these variables and innovation has been widely investigated. These include organisational culture and innovation (Hartmann, 2006), leadership and innovation (Jung, Wu and Chow, 2008) and organisational climate and innovation (Ekvall and Ryhammar, 1998). Studies into the role of the client in innovation have however had mixed outcomes. Whereas some writers such as Nam and Tatum (1997) have espoused the positive influence clients have on innovation in construction, others such as Ivory (2005) are more sceptical, suggesting that the client may have other priorities besides innovation.

This study aims to address this tension in the literature by investigating the role of the client in facilitating three different types of innovations. It will contribute to on-going debate about the role of the client in either promoting or inhibiting innovations and how that happens in UK construction professional services environment.

This paper initially reviews the key factors that influence innovation (i.e. client and innovation champions) in construction projects. The research methods are introduced, after which the three types of innovation are presented. Key findings and their implication on the construction industry are then discussed.

## **CLIENT INFLUENCE ON INNOVATION**

Hartmann, Reymen and Van Oosterom, 2008 (2008: 437) defines clients as ‘those actors who initiate, commission and pay for a construction projects. Clients in a construction projects in most cases represent multiple constituencies with varying interests. Whereas they prepare and communicate the requirement of the project ensuring that it meets the needs of the users of the project they also sometimes represent the owner and sponsor whose primary considerations may be cost. The clients’ decision regarding innovation may therefore be determined by how these several interests are balanced. Moreover projects by their very nature are associated with complexities, uncertainties and risks which results from such factors as multiple stakeholders with different interests, integrating the activities of a multidisciplinary work teams, political, budget and time constraints among others. These complexities mean that in a project environment where reducing risk is so important, innovation will not be willingly received and therefore the client’s role as an active promoter of innovation becomes important in adopting innovative approaches to delivering projects, Ivory (2005).



Unlike customers or client for many other products or services, clients of construction projects are very much involved in the process of design and implementation. Innovation may even take place in the client's premises. This provides clients of construction projects the opportunity to exert direct and indirect influence on the prospects of projects yielding innovative solutions (Hartmann et al, 2008; Winch, 1998).

Whereas calls have been made by various commentators for the client to take more of a leading role in facilitating innovation in the construction industry ( OGC, 2007), the client has often pointed to the manufacturing industry asking why construction client should shoulder this responsibility while manufacturing clients do not. Manley (2006: 1296) notes that 'the answer lies in the size, complexity and uniqueness of construction projects. Moreover, 'rather than being just buyers of finished products, owners of the construction industry are often major participants in the projects', (Nam and Tatum, 1997:263). This is more especially the case for repeat clients who will benefit from improvement in performance in the industry over time (Manley, 2006) as lessons from projects are passed on to future ones initiated by the same clients or different clients.

Construction clients are involved in the planning and delivery of projects and by so doing actively shape the process as well as the finished product (Gann and Salter, 2000). This makes the client's role in fostering innovation critical (Nam and Tatum, 1997). In a study of 3 innovative construction projects based in the Netherlands, Hartmann et al (2008) found that professional public clients' decision to adopt a new idea depends on whether the idea is perceived to perform better in meeting social requirements as opposed to traditional approaches without any negative impact on client's social responsibilities. Similar findings were made by Ivory (2005) in a study of the role of the client in promoting innovation in the design and construction of 3 buildings. Ivory (2005) found that the client would only allow innovation to the extent that it does not threaten the successful delivery of the project. The findings of the study also suggest that clients are not likely to support innovation if the client organisation does not stand to benefit from it. It's worth pointing out that in 2 out of the 3 cases studied, the paying client was not going to be the occupant of the building. It could therefore be expected that they would go for an innovation that will provide the needed services without taking on risk which they may classify as 'unnecessary'.

The client's innovation competence has been found to enhance innovation. Manley (2006), suggests that 'innovation competency' reflects an organisation's effectiveness in understanding the environment in which it operates, and in modifying its behaviour to maximise performance' (Manley, 2006: 1297). In a situation where the client is not innovatively competent, they may have an inhibiting influence on innovation performance in the construction industry; as such clients will not place sufficient demand on suppliers to instigate the search for innovative solutions. Moreover, where clients are overly concerned with cost, value adding offers are normally diminished (Ivory, 2005; Manley, 2006). Hence the ability of consultants or professional services providers to build up innovation competencies and achieve a reputation in the market place will depend on their ability to identify and work with clients that are willing to permit their projects to be used for the purposes of trying out the design and delivery innovation. The client's role in construction innovation cannot therefore be over-emphasised, (Ivory, 2005).

In an investigation into the context of innovation management in a Swiss based construction firm, Hartmann (2006) identified a number of variables which should be considered for successful innovation management. Key among the external factors is dependency on the client. This is hardly surprising as indeed the construction process is only triggered when a client decides to build. The dependency of the constructional tasks on clients creates a situation where each task conforms to the specific requirement of a single client, (Hartmann, 2006). The client's leadership in such context ultimately determines how innovative ideas perform whether in solving problems encountered in the project or in advancing innovations. Thus highly innovative and novel ideas are likely to require clients who are pioneering and have the requisite experience to be involved right from the beginning to make it a success, (Hartmann, 2006; Nam and Tatum, 1997; Slaughter, 2000).

Manley (2006) identified ways by which the client can promote innovation. These include demanding challenging project outcomes and emphasising quality project relationships. This relationship or social knowledge largely composed of culture norms existing as a consequence of working together and adding value to activities is important for innovation in professional service firms (Lu and Sexton, 2003). As a result of the co-production of construction products, there will be a high level of interaction between the clients and the project managers. It is expected that this interaction will influence project managers' perception of the project environment and constrain or support their championing behaviour and hence project performance.

Championing behaviour is defined as 'the project manager's observable actions directed towards seeking, stimulating, supporting, carrying and promoting innovations in projects, Dulaimi, Nepal and Park (2005: 566). Drawing from Dulaimi et al (2005), project managers' (PM's) championing role could be considered very important as PMs can provide direction and leadership towards the attainment of project goals. The PM as a leader of the delivery team can sell and promote innovative ideas to the other partners in the project, obtain their buy-in, coordinate input from other parties such as sub-consultants involved in the project and facilitate the implementation of ideas introduced into the project. The PM can also create an environment that will effectively boost the creativity of the team members, promote the generation of new ideas and develop an atmosphere where team members both internal and external to the PM's organisation collaborate to bring innovation to the project.

Nam and Tatum (1997) found that in 7 out of the 10 construction projects studied, the outcomes were influenced significantly by individuals who actively championed the innovation. This notion of champions 'making innovation happen' has been called into question by Markham (1998) who suggested that this view of champions is speculative. However, Dulaimi et al, (2005) in a study involving 32 project managers and 94 project team members who worked on various construction projects confirmed how important champions are to the success of innovation projects. Dulaimi et al (2005) suggested that creating the right environment could enhance the innovation championing behaviour of project managers. This support could come in the form of clients' backing for innovation.

From above it could be deduced that there is no agreement among researchers as to whether clients influence innovation positively or negatively. Also a number of the papers reviewed have rather focused on the clients' attitude to risk and the decisions that clients make whether to adopt an innovative idea. This paper suggests that there are other more subtle ways by which clients can influence innovation in construction

project during the design and project delivery. This happens when client actions and inactions influence innovation championing behaviour of project managers which in turn impact on innovation performance as depicted in figure 1 below.

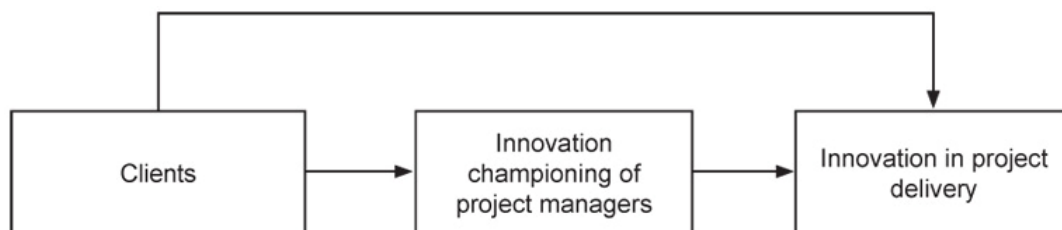


Figure 1: Conceptual model

From the for-going, this study will be relevant in addressing two questions;

Do clients have a positive or negative influence on innovation?

How does this impact on innovation outcomes in practice?

## CASE STUDY CONTEXT

The division under study currently has a term consultancy contract with a London Borough and provides services for that authority only. The contract covers highway design and maintenance services. The office is located very close to the client. It is considered that the close proximity of the office to the client will encourage more interaction among clients and designers. The contract was originally for four years with a possible extension of another two years. The four year contract has about one year left and the company is keen to secure the extension. This is very important to the company especially in the light of the current economic circumstances and therefore every effort will be made to provide services that meet and exceed the client's expectation. At the time of the study the division had about 40 staff grouped into three teams. The first team provides routine maintenance services, the second planned maintenance services and the third, capital improvement services. The contract has about 17 key performance indicators (KPIs) which relates to delivery of services. These include delivering design and supervising implementation (by the term contractor) to programme and budget.

## RESEARCH METHOD

This research seeks a deeper understanding of contemporary events which does not require control over behavioural events. The research questions posed were generally "how and why questions" aimed at having a deeper understanding of a complex phenomenon relating to how such a key actor as the client influences innovation in a construction professional services organisation. The case study approach was therefore considered most appropriate, Yin (2003). Furthermore a case study method is more suitable for research work if; "the research aims not only to explore certain phenomena but to understand them within a particular context", Collis and Hussey (2003: 69). That made it important for the purposes of illustrating how the client interacts with project managers to make innovation a reality to undertake an in-depth study in a particular context, Winch (1998).

A preliminary interview was held with the Divisional Director in order to identify the innovations to include in this study. The interview focused on recent innovations implemented by the division. Subsequently three types of innovations, one from each team, were selected for study. Since the parties involved as well as the dynamics of

these innovations are different, they were treated as sub-units for analysis embedded within the bigger case which is the division. Details of the responsible PMs in each of these innovations were obtained. A pre-interview information sheet was sent to the project managers highlighting why they had been approached and what they could expect at the interview. The information sheet also provided assurances of confidentiality.

The aim at this stage of the on-going study was to examine the role of clients as part of a larger on-going research seeking to identify the key factors that influence innovation championing behaviour of project managers and hence innovation outcomes. The study adopted the semi-structured interview approach with guiding questions derived from literature. For each innovation an interview was set up with the PMs on the processes that led to the adoption of the innovation with an emphasis on the role of the client. The interviews covered areas including the background, the key drivers, the client's attitude to the innovation and their contribution and their motivations among others. The interviews were tape recorded and transcribed verbatim. Using content analysis method, the data was analysed and emerging themes identified. Interviews therefore formed an important source of evidence in this study as they helped to focus directly on the case study topic and provided more insightful information, Yin (2003).

Interviews however cannot easily be replicated. Another limitation of this approach is that the PMs of the three innovations studied may have overstated their own contribution while downplaying the contribution of the client. In order to overcome these weaknesses, other sources of information were used. These included further interviews with the Divisional Director of the office and the Business Unit Director to supplement the information gathered through the semi-structured interviews. In addition artefacts (equipments and devices) associated with the development of the innovations were also reviewed. These multiple sources were to enhance the validity of the data gathered.

## **FINDINGS AND DISCUSSIONS**

### **Description of the innovations**

Three different types of innovation were studied to examine the role of the client in each innovation and how that influenced the innovation outcomes. The first innovation was driven primarily by the need to improve internal efficiency while delivering improved services to the client. The key driver in the second innovation was saving cost for the client while the third was driven primarily by the need to meet and exceed client expectation and improve profitability. These are briefly described below to help put the study in perspective.

The first innovation involved the development of a new system of capturing, monitoring and reporting on a large number of small schemes running concurrently to the client. The system comprised of individual spreadsheets for each scheme tailored for the specific reporting requirements that was kept on the project file. A separate master spreadsheet was prepared and an excel programme (macro) was developed to automatically pull in all the relevant information from the individual spreadsheet into the master spreadsheet for weekly reporting to the client. This saved a lot of time and effort on the part of the PM which would otherwise have been spent scanning individual files and talking to individual engineers to obtain the relevant information.

The second innovation involved a change in the paving material that was being used for the construction of vehicle crossovers in the client's borough. The client generally recommends the use of fibre reinforced slabs by their contractor in areas of footway normally driven over by vehicles (vehicle crossovers). These were however much more expensive than the normal paving slabs. To test whether the use of the reinforced slabs was value for money, an experiment was undertaken using different types of paving slabs. These included normal paving slabs, fibre reinforced and steel reinforced slabs placed on different depths of concrete in one of the busiest vehicle crossovers in the borough. After six months, it was found that the normal slabs withstood the pressures as well as the fibre reinforced ones and in some cases even performed better. This confirmed that the performance of the paving slabs is influenced not only by the strength of the slabs but the conditions under which they are placed. The decision was subsequently made to use the normal slabs across the borough saving money in the process.

The third innovation involved the configuration, setting up, purchasing, testing and installation of a system that would facilitate real time data collection and transfer between a team of site inspectors and the data base on the company's server in the office. The system was originally suggested by the Business Unit Director having seen a similar one demonstrated by the Rail Division of the company. The intended objective was to have a system that was able to capture site conditions including pictures that will be directly linked to a specific location using the Global Positioning System. In the process other functionalities were introduced including the development of a Virtual Private Network (VPN) that enables secure access to the company's network. The VPN was necessary to bypass the existing requirement for a Vasco token to access the server externally. The system comprised of a tough book which has a 3G sim card with a mobile internet connection that can transfer real-time data. The new device also has a Wi-Fi, an in-built camera, an in-built blue tooth system. This replaces a very bulky tough book double the size which had to be carried together with a camera, and an external GPS unit. The system which is about 95% complete will improve the efficiency of site inspections saving time and enhancing the accuracy of data collected.

### **The role of the client in innovation**

The role of the client varied in the three innovations studied. With the first innovation, the client's role was limited to occasional complaints about inadequate and not up to date information. These complaints may have served to stimulate the PM's championing behaviour as the PM set out to look for a means of a more accurate and efficient reporting to the client. With the current contract gradually coming to a close and the consultant keen to obtain the extension, any client concerns is likely to be taken more seriously. The client was involved in agreeing the relevant information to be included in the master spreadsheet. They determined what information should be passed on to them. Hence it could be seen that the client set the expectation although the client was not directly involved in the development process. The PM commented that 'yes, we sent them an initial layout of what we intended to provide and then they provided their feedback ... and then once they have provided their feedback we made changes'. This notwithstanding the evidence suggests that the desire to be efficient was as much a driver of the innovation as the need to address client concerns.

The client had more involvement in the third innovation. This was down to the specifying hand held solution as a requirement for the highways inspection team. The

client's role is also reflected in insisting that the solution specified in the contract is used and officially complaining when the client observed the site team undertaking inspections with notebooks and pens instead of the specified solution. Hence the client was in this scenario once again setting the requirement and expectation. This is consistent with the findings from similar studies about the client's role as a leader in setting performance expectation that enables innovation (Nam and Tatum, 1997). However the client's role stopped short of any involvement in the development process. According to the PM 'the client had a very stand off approach to it, the client was like ... this is your contract and you do it the way you like ... we are not really interested'. This resonates with Salter and Gann's (2003) findings in the study of Arups that clients in some cases are quite distant from the everyday concerns associated with designs and are therefore not able to contribute meaningfully to the development of ideas. Keegan and Turner (2002) also found that conservative clients could have an inhibiting effect on innovation when specifications are made mostly through briefs that are inflexible in relation to project outcomes. Nevertheless, in this scenario, although the client did not participate in looking for the solution, there was evidence to suggest that the client insistence on the hand held electronic solution influenced the PM's search for a new solution. It could therefore be said that the client indirectly influenced the innovation by influencing the championing behaviour of the PM.

The client however had most involvement with the second innovation. This is not surprising given the direct benefit of this innovation to the client in terms of cost savings. This finding is in line with the findings of (Hartman et al, 2008 and Ivory, 2005) that a client is more likely to adopt a particular innovation if they consider that there will be a direct benefit with minimal risk to their organisation. The client using his local knowledge identified one of the most trafficked crossovers in the Borough where the experiment could be undertaken. The contractor was also on board in this experiment; working together with the PM. As Briscoe et al (2004) rightly pointed out that the client can promote innovation and performance in the industry through various means including encouraging the integration of the supply chain. Evidence suggests that the client displayed leadership in making this innovation a reality as the consultant and the contractor were brought together for the successful delivery of the experiment and subsequent application. The client in this instance had a direct influence on the innovation introduced. This finding suggests that beside the need to make good use of the funds generated by the client (capital budget), the client's direct involvement and interest may also be due to a higher level of competence in the particular area where the innovation occurred.

The evidence from all 3 innovations indicate that actions taken by the client either in complaining, specifying requirements for delivering particular services or practicably getting involved influenced the innovation either directly or indirectly by stimulating the innovation championing behaviour of project managers and hence effort to search for solutions which ultimately led to the innovation. The client also in the second innovation used his local knowledge to directly influence the direction of the innovation and thus contributed to the success in the innovation.

An interesting finding worth noting is that the contract under which the projects were delivered had a large number of key performance indicators (17 KPIs) which had financial penalties attached to them. None of these however related to innovation. Commenting on the contract, one of the PMs stated that 'the client is very demanding and sets very high bars so as consultant working for him...we have to jump high to

reach the bar and what he demands'. The statement above reflects the indirect impact clients can have on the decisions and choices of PMs in relation to innovation. The findings from this study are also in line with Hartmann's (2006) findings that the changing demands and expectations from the client may prompt the development of innovative solution in response as the client is the initiator of the construction process.

In 1 out of the 3 innovations, the client had a high level of involvement. This was down primarily to the fact the funding for planned maintenance came from capital budget directly overseen by the clients. The client therefore had a keen interest in making the best use of that budget. In that direction, any steps that will achieve that goal was very much welcome and fully supported. This adds credence to the general notion that the cost associated with construction projects and the results should an innovative project fail to live up to the expectation is a key factor accountable for the generally high levels of conservatism among construction clients, (Nam and Tatum, 1997).

## CONCLUSIONS

The aim of this study was to examine the role of the client in fostering innovation in construction professional services firms. It involved a study of three types of innovations. Preliminary findings suggest that clients will support an innovation where there is a direct benefit to the client organisation with minimal risk. Client influence innovation by direct involvement in the decision making as in the second innovation or indirectly by setting the performance expectation and by complaining where project expectations are not being met. With the reliance on the client setting the expectation, innovation will be inhibited if the client does not set high enough standards or expectation, (Ivory, 2005). The findings also suggests that the client exert influence indirectly by helping to create an environment that encourages the project manager to adopt more championing behaviour.

To promote innovation and advance knowledge across the industry, it is important for construction organisations to identify clients with high levels of innovation competence for collaboration. Such clients are more likely to accept and support innovation in projects. Organisations could help enhance the innovation competence of clients through joint workshops and seminars to share knowledge with the client. Construction professional services firms can also provide training that will enhance the championing behaviour of PMs. PMs can promote innovation by advancing the advantages of innovations. This could in turn trigger a positive response from clients to facilitate innovation in projects.

Clearly, these preliminary results cannot be generalised to all professional services firms in the construction industry. The study was focused on only one division of the company and whereas that facilitated an in-depth study, it also limits the opportunity to generalise the finding across the whole organisation. In order to study this phenomenon across the organisation, the next phase of this study will undertake a survey of project managers. This notwithstanding, the study tracked the influence of this key constituent through the stages of the innovation process which does not come through in a quantitative survey. It will be interesting to observe overtime the impact on innovation of various changes in client requirements. This will elicit a longitudinal study design for future studies.

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# IMPERVIOUS BUILDING (COATING) MATERIALS' WORKABILITY IN SOUTHWEST NIGERIA: A CASE OF AKURE, ONDO STATE

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The prevailing weather condition in Akure in south-western Nigeria which is characterized by high humidity and rainfall coupled with obvious global climatic changes are impinging on the building fabrics. The effects of surface and ground water on buildings in the area calls for a cursory look into finding means of militating against its penetration which will consequently reduce the aesthetics and structural value of the buildings. This paper is aimed at finding solution to the occurrence of extensive capillarity in buildings in the area. A thorough survey was carried out through the administration of well structured questionnaire on randomly selected buildings in all the twelve zones of the city to determine the use or otherwise of impervious materials and their implication(s) on the buildings in the area. Physical measurement of capillarity in randomly selected buildings was also carried out. Most of the buildings investigated suffer from various degree of water penetration due to non application of impervious materials in virtually all the areas of the city. The use of, the inevitability and advantages of impervious (coating) materials in the area are not properly harnessed. The incontrovertible findings point the way forward in the application and use of water resistant materials in the warm humid zone of Nigeria to prevent dampness in buildings.

Keywords: building materials, impervious, capillarity, water.

## INTRODUCTION

Water, an inevitable requirement for human settlement could turn around to harm mans' existence and even destroy the whole habitat when not properly managed. To build a house in the developing countries is practically impossible without the use of water. Olujimi (2005) reveled that of all the common resources available to man, water is universally accepted as the most essential for virtually all human activities. This agrees with Okereke (2003) who avers that water is an important ingredient for making concrete the most prominent constituent of buildings. A significant percentage of water is used during construction of buildings (for example see Folorunso, 2002). Ume and Okereke (2008) complement the assertion by agreeing that availability of water is essential to human habitat development though with many consequences.

Kamnetzky (1991) discovered that water used in building construction has to eventually evaporate until the materials reach their normal state of dryness in order to forestall early depreciation. The exposed surfaces of materials usually dry earlier than the interior surface due to exposure to elements of climate such as solar radiation and wind. During the process, moisture is drawn to the surface thus forming irregular

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patterns on the finishes after drying. Lack of adequate protection for walls allow them to become saturated with rain, surface and ground water which will result in dampness of the interior and discolouration of the exterior.

Dampness is as a result of the presence of water in the interior, the wetness of wall and floor surfaces, and the upward movement of water in the semi-permeable membrane (capillarity) of the building fabric and presence or closeness to a body of water. The presence of two rivers called by the same name 'Ala' and other smaller streams in the city make it impossible for buildings to be sited far from bodies of water. Fadairo (2006) agree that the erosion crisis (excess of water) in the study area have reached such an alarming state that deserves serious attention and pragmatic approach to salvage the built environment.

The built environment consist principally of buildings and there attendants services. Olotuah (2002) opined that the provision of services is essential for healthy living. This will enhance the value and functionality of the dwelling units. The environment serves as the host to any building; this explains the influence it exerts on the structures and occupants. The prevailing weather condition in any area coupled with obvious changes in global atmospheric condition combine together to impinge on the life span of overt building fabrics. Southwestern Nigeria is exposed to tropical rain for the longer part of the year between 8-9 months. This paper examines the effect of moisture on buildings in the area due to non usage of impervious materials.

## **SOURCES OF DAMPNESS IN BUILDING**

Addleson and Rice (1991) observed that ground water lowering, especially repeated lowering and raising of water level in loose granular soil which tend to compact the soil and level in fine grained soil may introduce settlement because of the extension of water from the voids. Movement of water into the building is enhanced by loose soil particles. Porous soils especially sandy and loamy soils prevalent in the study area are highly permeable. This Eze (2005) described as the reason for quick saturation and liquefaction of the built environment.

Small or apparently insignificant cracks resulting from plastering defects may provide the initial paths for water to penetrate and cause dampness. Building features that do not protect it from rain include small overhangs of eaves like cornice and verges, flush coping stones, recessed mortar joints, sills without drips and parapet walls. The presence of cavity insulation other than the closed cell type may exacerbate the problem thus keeping the wall damp for longer time during the dry season. Masonry walls expand and contract vertically and horizontally in response to changes in moisture content and temperature (Folorunso, *ibid*)

## **PROMINENT IMPERVIOUS MATERIALS IN NIGERIA**

An impervious material is a material which cannot be penetrated by water and various types of moisture. While some are used directly in building, some are used as additives to enhance the resistance of the base material. Arayela (2000) states that such materials are stabilizers which are complimentary additions to products in order to enhance the quality and life span of buildings generally. These materials are also referred to as sealants, these include:

**POLYMER** – A macromolecule built up by the reception of small, simple chemical units covalently bonded together. Polymerization according to Okereke (*ibid*) is the process of converting monomer molecules to polymer. It comes in form of plastic,

rubber and fibers (silicones) protein (animal origin) and cellulose (from plants) are natural polymers while plastics and rubber are synthetic organic polymers. Silicone is synthetic inorganic polymers. It has low temperature resistance and cold flow (creep). It is used as waterproof in concrete in form of binding agent and polydispersed isometric filler.

**EPOXY PLASTIC** – These are the most widely used epoxy resins which are based on the condensation reaction of epichlorohydrin and bisphenol A. They possess a high degree of adhesion, extreme toughness, good flexibility and are the best chemically resistant thermosetting plastic.

**SILICONE BASED WATERPROOF** – These are sealants that protect building materials from water damage. They also protect the surfaces and structural integrity of building from ultraviolet rays and extreme temperatures. Application of these is better at the sub-structure level of building, because it cannot be painted over.

**POLYURETHANE SEALANT** – This helps in blending waterproof sealant with the surrounding décor. It can be painted over. It does not shrink and not easily damaged by abrasion. However, it has a shorter life span than silicone sealant, lesser ability to withstand extreme temperature and ultraviolet rays (Ranka, 2008). This type of sealant is not environment friendly.

**BITUMENEOUS SEALANT** - Encarta (2007) described it as naturally occurring mixtures of hydrocarbons. This agrees with Okereke (ibid) who asserts that it occurs in form of crude petroleum, asphalt and tar. Bitumen is characteristically dark brown or black and contain little nitrogen, oxygen or sulphur. Bituminous materials soften when heated. It can be prepared and applied in a wide range of concentration. A layer or layers of bituminous material can be applied between the foundation wall and the damp proof membrane DPM to protect it from water percolation. It can withstand both hot and cold temperature. It is best used in water prone areas in building such as foundation and roof decks. It is emulsified for the production of bitumen emulsion and applied on concealed walls (Arayela, ibid). Okereke (ibid) agreed that bitumen is a non-metallic derivative which may exist as gases, liquids, viscous liquids or solids and which are soluble in carbon disulphide.

## **STUDY AREA**

This study was carried out in Akure the state capital of Ondo State. Ondo State was one of the three states carved out of the old Western Region of Nigeria in 1976 in a drive to get government closer to the people. It was relatively an emerging town before the state creation. The human population of Akure according to 1963 National Population Census was 71,106. It grew to 190,000 by 1991 census and 353,211 by 2006 census. This figure can also double in the next 15 years.

It lays on latitude  $7^{\circ} 15'$  North of the Equator and longitude  $5^{\circ} 14'$  East of the Greenwich Meridian. Being a tropical city, it enjoys an annual rainfall of over 1500 millimeters. The micro-climate is influenced by abundant sunshine. The southwest trade wind blows across the area for over eight months in a year with relatively high humidity. The city is transverse by two major rivers. These rivers bear the same name as River Ala. However, other minor streams and waterlogged areas are prevalent. Akure is known-as it is typical for all other settlements in southwest Nigeria- for its dual maxima rainfall periods between June and August and a monthly temperature range between  $25^{\circ}\text{C}$  and  $29^{\circ}\text{C}$ . The humidity ranges from 66% in January to 85% in September.

## RESEACRH METHOD

Akure is divided into twelve historical zones due to historical evolution (Olotuah, *ibid*) and (Bobadoye, 2005). These are:

1. Erekesan-Erekefa;
2. Idiaagba-Ijemikin;
3. Obanla;
4. Okegan;
5. Adegbola-Ayedun;
6. Gbogi;
7. Isikan-Oke Aro Titun;
8. Oke Aro;
9. Ala;
10. Alagbaka;
11. Ijapo; and
12. Isolo

Source: Olotuah, 2002

Data used in measuring the performance of impervious materials in the buildings within the metropolis was obtained from a field survey carried out by the researcher. Personal observations were made and measurement taken in respect of upward movement of water (capillarity) in one randomly selected building from each segment of the city for a period of five (5) years.

A well structured questionnaire was used to obtain data from randomly selected professionals in the building industry practicing within the study area, home owners – developers and tenants across the entire city. A total of 130 questionnaires were administered in order to have a sizable response, balance appraisal and judgment. A total of 120 questionnaires were returned while 10 could not be retrieved. 45 of the respondent are professionals in the building industry while 75 are others earlier mentioned.

Variables examined include the types of impervious materials used, the thickness of the materials, the stage it was applied, methods of construction, and the interval or period during which maintenance was carried out. Other variables examined include the age of buildings, proximity to rivers, stream and water logged areas.

## DATA PRESENTATION AND ANALYSIS

The results obtained from the questionnaires administered on respondents in all the zones of the study area are as follows:

Table 1: Building industry practitioners in Akure.

Profession	Num.	Average yr. of experience	Average num. of projects
Architects	18	25	126
Builders	10	10	38
Civil Engineers	10	27	132
Mechanical Engrs.	07	12	43

Table 1 provides information on the involvement of selected professionals in the building industry practicing within the area; their average years of experience and number of projects handled.

**FINDINGS:** With few numbers of projects handled by the professionals despite the huge number of house population, it is apparent that most buildings emerged without the input of relevant professionals. This consequently implies that minimum standards were not followed. Though the Architects have handled more projects than others except the Civil Engineers yet most of the buildings in the area were designed without the impute of Architects. This means that developers do not have the privilege of professional first hand advice.

Table 2 indicated the constituents of foundation as a building component, the materials used and the method of construction. 16.7% of the building was built with oversite concrete known as ‘German floor’ in the local parlance. Only an insignificant 1.7% had sealant or impervious materials underlay that can prevent the concrete and entire building from dampness. From the table above, the effectiveness of sealants like epoxy, bitumen etc. is not embraced. The normal way of constructing a building with concrete floor to complete the substructure is not in practice. 72% of the buildings show that foundation blockwork are allowed to continue to roofing level without the introduction of any water resistant material.

Table 2: Method of construction/ materials used for foundation protection.

Methods	Number	Percentage
Construction of oversite conc. floor (German floor) before erecting the superstructure	20	16.7
Placement of impervious materials before conc. floor	2	1.7
Construction of damp proof course DPC without oversite concrete	36	30
No provision for all above	72	51.6

Table 3: Materials used for wall protection

Materials	Num.	%	discoloured	%	Not discoloured	%	Frequency of maintenance
Paint	80	66.7	72	90	8	10	2-5 years
Ceramic tiles	5	4.2	-	-	5	100	Once in 30years
Sealants	1	0.8	-	-	1	100	Once in 20years
Plastering	31	25.8	30	96.8	1	3.2	5-10 years
Unplastered	3	2.5	3	100	-	-	Every year

Table 3 indicated the materials used for wall protection against moisture and devaluation of surfaces. There is near to zero usage of sealant and impervious materials in general. This is the major cause of dampness in walls in the area. The high rate of humidity and rainfall is impacting negatively on convectional materials such as paint used majorly in the area. Painted surfaces are being maintained in every 2-5years. While walls finished with sealants need to be maintained in every 20years those finished with ceramic tiles will last longer. Walls rendered with plaster but not painted are repaired in 5-10years. Unplastered walls which are becoming rare in the area are repaired every year.

Table 4: Condition of buildings

Present condition	Number affected	percentage	Average age
Poor ventilation	42	35	City core 40
Roof leakages	21	17.5	
Buildings subject to flood	39	32.5	
Buildings with efflorescent growth	66	55	Fringes 10
Dampness in walls above dado	93	77.5	

Table 4 presented the existing conditions of the buildings investigated. The average age of building within the city core areas such as Erekesan-Erekefa, Idiaagba-Ijemikin and Obanla is 50years while the average age of buildings within the city fringes (new areas) such as Alagbaka and Ijapo is 15years. 77.5% of the buildings are experiencing dampness due to proximity to water bodies, high density of ground water and loose soil particles prevalent in Akure. This combined with 32.5% of buildings subject to seasonal flood has resulted into 55% efflorescent growth on buildings.

Table 5: Measurement of Capillarity in Building.

Area	N	Age	Impervious materials	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yr. 5	Capillarity impact
1	1	56	Non	10-25	25-41	40-54	54-70	70-85	850mm above fdt.
2	1	52	Non	10-30	30-52	52-70	70-90	90-110	1.1m above fdt.
3	1	53	Non	10-30	30-70	70-90	90-110	110-140	1.4m above fdt.
4	1	26	Conc. Floor	10-18	18-26	26-34	34-42	42-50	500mm above fdt.
5	1	30	Non	10-25	25-40	40-55	55-70	70-87	870mm above fdt.
6	1	36	Non	10-25	25-40	40-55	55-70	70-85.4	854mm above fdt.
7	1	22	DPC	-	-	-	-	10-15	150mm above fdt.
8	1	21	DPC	-	-	-	-	10-17	170mm above fdt.
9	1	32	Non	10-25	25-40	40-55	55-70	70-85	850mm above fdt.
10	1	16	Conc. floor	-	-	10-15	15-20	20-25	250mm above fdt.
11	1	6	sealant	-	-	-	10-15	15-20	Below fdt.
12	1	11	Conc. floor	10-15	15-22	22-25	25-31	31-35	350mm above fdt.

Table 5 presented a painstakingly taken direct measurement of capillarity on selected buildings over a period of 5years across the city. Buildings built over 30years in the study area do not have oversite concrete and any method or material for preventing water percolation through foundation and walls. The impact is capillarity that ranges between 850mm-1400mm above foundation wall (up to middle of window). Those built with oversite concrete or DPC but in floodable, water logged areas have dampness impact of 150-500mm above the concrete or DPC level. The impact of capillarity in the only building with sealant like bitumen underlay before concrete



floor is only below the dado wall. No impact occurs on the superstructure, no dampness in the interior and no growth of efflorescent.

## CONCLUSION AND RECOMMENDATION

Ranka (ibid) observed that buildings that are not protected with impervious materials can absorb over 1liter of water per sq.ft in 6 hours during 32km/hour of driving rain and a concrete block will absorb 2liters of water under similar conditions. Rainwater absorption and highly dense ground water are causing multiple damages to buildings in Akure, Nigeria due to non usage of impervious materials. These damages include but not limited to aesthetic damage such as growth of efflorescence, paint peel-off and discolouration, fungi growth and structural damage such as corrosion of reinforcement bars leading to loss of ductility and strength. Cement also loses its grip, expansion and contraction of walls lead to cracks.

Application of impervious materials is not a usual practice in the area. This should be enforced through appropriate legislation. The use of these materials will be of economic advantage as this will reduce the frequency of maintenance. The application of ceramic wall tiles will increase the city aesthetics and reduce wall maintenance. It is further recommended that:

Buildings should not be allowed to evolve without the input of relevant professionals. Jolaoso (2005) observed that failures in buildings in Nigeria occur principally because of lack of engagement of competent professionals.

Relevant agents of government should be awakened to their responsibility of supervising the construction process to ensure compliance with development control.

Prospective developers should be enlightened on the advantages of using impervious building materials by the professionals.

Workshops and seminars should be organized to intimate professionals with the latest development in impervious materials.

Further research should be carried out on how best to include impervious additives to building materials to prevent the percolation of water.

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# INTRODUCTION OF BUILD- OPERATE -TRANSFER (BOT) MODEL INTO MAIN STREAM FUNDING OF INFRASTRUCTURAL PROJECTS IN GHANA

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Ghana is about 238,500 km<sup>2</sup> area in dimension just about the size of UK. The population is about twenty two million. Economic and Social Infrastructural facilities development such as transport, power, water, prisons, hospitals, schools etc are mainly funded by government through existing models that depend on Government Revenue/Loans and Donor support. Currently, in practice, very little is known about BOT, which encourages private sector financing of infrastructural projects through partnership agreements with the Public. About 40% of the Nation's budget is spent on road construction alone, yet the country cannot boast of an excellent road from Accra, the capital to Kumasi the second capital. Almost all the above mentioned infrastructural facilities are in short supply. Clearly the existing models of funding infrastructural projects in Ghana have proved inadequate and ineffective in ensuring the desired accelerated level of growth needed by the economy for transformation. The paper examines the possibility of adopting BOT Model into main stream project financing especially road infrastructure. It explores the impact to be derived from the introduction of BOT Model and the compatibility of BOT Model with the existing Models. Existing literature was reviewed. Targeted officers and a section of drivers were interviewed. Case Study was employed to establish a business case. The paper concluded that BOT Model is an option that can complement existing Models.

Key words: BOT, infrastructure, funding, private sector, partnership, Ghana.

## INTRODUCTION

Build-Operate-Transfer (BOT) is a type of Public Private Partnership (PPP) which provides a framework for the private sector to invest directly in infrastructural projects. It is a means of bringing together social priorities with the managerial skills of the private sector, relieving government of the burden of large capital expenditure, and transferring the risk of cost overruns to the private sector rather than completely transferring public assets to the private sector, as with other PPP methods i.e. Privatization, Management Contracts, etc. (Spackman, 2002)

The structure of the Model facilitates the transfer of 100% responsibility for the development and the risk of finance, design, construction and operation of a public infrastructure facility from the public to the private sector, under a period- defined concession. The concept is seen as a medium which is used to fund large and medium size infrastructure projects such as roads, dams etc without draining the public purse (Baidoo, 2001).

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BOT is seen as 21<sup>st</sup> Century Model for financing infrastructure projects. Many developed and developing countries, the world over have adopted this Model because of its immense benefit in infrastructural project delivery through BOT; i.e. USA, UK, China, Philippine- Power generation, Turkey- Railway Network, South Africa etc is enough testimony that Ghana can no longer turn her back at this glaring opportunity with the current huge challenges in road infrastructure development.

Despite the difficulties various governments in Ghana go through in delivering infrastructural projects especially roads due to funding, the construction industry has seen very little or nothing on BOT. These difficulties are evident in the outcomes of various programmes embarked upon by successive governments in Ghana namely; *Vision 2020, Poverty Alleviation Strategies, Actualization of Golden Age of Business, Consolidating Gateway Initiative, Wealth Creation and Millennium Development Goals* and others like *Beautification of Accra, Dualization of Accra Kumasi Road* to mention a few. In all these programmes, accelerating Economic and Social Infrastructural development such as transport, power, water, prisons, hospitals, schools etc have been key or central to these programmes. Yet an inventory of such amenities clearly shows that after 53 years of nationhood not much have been achieved in terms of infrastructural development.

There is a huge gap in the demand and supply of infrastructural development in Ghana. A cursory look at road infrastructural facilities revealed that out of the 51,202 km length of road only 18% has been paved as against 82% unpaved (Road Survey Report, 2003). These figures are at the instance where, for some time now, about 40% of the Nation's budget is consistently spent on road construction alone. Urban and Rural water backlog are 55% and 48% respectively (Daily Graphic August 7, 2007). The Rail Network is at the verge of collapsing. The housing sub-sector is also experiencing a backlog of about 500,000 housing units while supply figures are between 25,000 and 40,000 units per annum as against an annual requirement of 100,000 units (Daily Graphic, November 7, 2007). Schools, hospitals, energy sector, agriculture as well as manufacturing sectors of the economy lack adequate infrastructural facilities for development.

The situation stems from the fact that these programmes relied on the conventional financial models which depend heavily on Government revenue, loans and donor support; i.e. Consolidated Fund of Ghana(GOG), Road Fund etc. These funds are limited in the sense that it depends on the performance of a government to expand the tax net of her tax machinery which also is dependent on whether the citizenry can afford to pay. Again, external loans acquisition and donor support depend on factors like debt servicing, governance, transparency and other benchmarks which African governments find very difficult to meet due to lack of political will. Even where these loans (life lines) come, they come with conditionality that is inimical to true development. Currently a lot of infrastructural projects have stalled because government cannot pay contractors (Budget of Ghana, 2010).

It is against this background that the Build-Operate-Transfer (BOT) Model which is a type of Public Private Partnership (PPP) and appropriate for the Construction Industry in terms of accelerating infrastructure projects delivery in particular is being proposed to augment the existing Models which have held the fort till today in Ghana. BOT which encourages private sector financing in infrastructural projects through partnership agreements with the public is being hailed by industry, governments and multilateral banks as the wonder solution to financing large and medium size

infrastructure projects such as dams and roads etc to create public infrastructure (World Bank 1996).

The benefits enjoyed by both developed and developing countries through BOT Model and the potential it holds for Ghana in terms of bringing road infrastructure to all parts of the country which has eroded Ghanaians since independence engineered this research

## JUSTIFICATION FOR BOT INTRODUCTION

Investing in public infrastructure is conventionally considered to be the necessary pre-requisite for industrialization and economic growth. Though this is seen traditionally by many as the sole responsibility of government, it is evidently clear that Ghana, in her bid to attain the objectives of *Millennium Development Goals* is struggling to provide infrastructural facilities particularly road. But road infrastructure is the basic element in terms of opening up the country for the industrialization that would ensure middle income status. Hence the huge infrastructure gap between supply and demand (Owusu, 2007).

This is at the instance where Ghana has implemented different models of industrialization since independence without success of transforming the economy; i.e. from Arthur Lewis Dual Economy Model, Import- substitution Model to Export – Led Industrialization Model. In all this apart from poor planning the failure has been heavily blamed on financial constraints.

Another Industrialization Plan is in the offering based on oil revenue predictions by International Monetary Fund (IMF) that Ghana will gain US\$1 billion annually for 20 years in crude oil from her oil and gas resources. But according to Adams (2009) the reality is that this is lower than the budget deficit for the first three quarters of 2009 which stood at GH¢2.2 billion. The oil revenues are therefore not going to meet the development budget of the country. Again consistency of inflows may be affected due to volatilities in crude oil prices. Therefore, annual revenues may not even be US\$1 billion. The foregoing argument indicates that all the existing financial Models which depend on the above sources of funding alone cannot do the trick.

Introduction of BOT would free the public purse and erase the thinking that despite the huge capital outlay required for infrastructural projects, government should be the sole provider of roads, bridges, ports, power plants, public utilities, etc. Again this creates the ‘paradigm shift’ from government to private financing of infrastructural project. The past decade has seen a new global economic trend emerging, and actively being supported by the World Bank group, which emphasize privatization, economic deregulation etc. among the models BOT is one model currently being promoted by World Bank group as mechanisms which enable direct private sector investment in infrastructure projects, ostensibly as a strategy for reducing the drain on state revenue, increasing efficiency, and enhancing private sector development (Baidoo, 2001).

The above argument clearly indicates that the introduction of BOT Model in Ghana to augment the existing Models in funding road infrastructure is indispensable.

## RESEARCH QUESTIONS

The key questions that influenced the study were as follows:

Is it possible to adopt BOT as model of funding road infrastructural development in Ghana?

How can BOT model impact on development of road infrastructure in Ghana?

Would BOT Model be compatible with the existing road funding Models?

## RESEARCH METHOD

The study tried to establish the viability of BOT in infrastructure development and in particular road construction. The study was therefore narrowed to road infrastructure development. The study was in three phases. Purposive sampling was adopted for the 1<sup>st</sup> phase, since the information required was technical in nature and could be provided by a population with some specialties/expertise in the area of road construction and in certain key departments. Four agencies/departments on roads namely; Ministry of Roads and Transport, Ghana Highway Authority and, Urban Roads were targeted as well as 1<sup>st</sup> class Financial Institutions and Construction Companies in Ghana.

In all twenty (20) executive officers from the above mentioned agencies were interviewed to solicit answers for the key research questions in the 1<sup>st</sup> Phase. Ten (10) executive officers of Ghana Highway Authority (GHA) were interviewed in the process. These executive officers were heads of sections in the agency. Ten (10) out of the twenty (20) because their agency is in charge of the very road corridors BOT Model is being proposed (that is selected Highways in Ghana). Three (3) executive officers from the Department of Urban Roads/Ministry of Roads and Transport were also interviewed. Finally as an anchor in terms of investment and local interest, four(4) executive officers of two(2) high profile Banks and three (3) 1<sup>st</sup> class Construction Companies were interviewed to find out the local interest. Each of the last two questions was restricted to either officers from the road sub- sector or officers from companies.

The 2nd phase involved a case study of two roads namely; Accra Kumasi and Kumasi Berekum roads to establish a business case through investment appraisal. This exercise was included in the paper to demonstrate or check the viability of BOT in the road sub-sector. Data on the two roads ranging from traffic census, vehicle groupings as well as toll fare to cost of building Asphalt GHA Institutional road in Ghana were gathered and analyzed to assess the payback period. Net Present Value method was used to assess the returns on investment up to the 20<sup>th</sup> year of BOT operation on these two projects. The Net Present Value method was used for the analysis because it's recognized the effect of time value of money; that is the effect of interest rates, etc hence the recommended modern method of

investment appraisal Harris and McCaffer (2001).

The 3<sup>rd</sup> phase involves an accidental sampling of 200 drivers through interview on the two selected roads to establish their willingness to pay even higher toll if an excellent road is built. Accidental sampling was used because the opinion of drivers on this question is a public knowledge. This came to light through various public interviews by both print and electronic media reporters during the recent toll increases in Ghana. This part was included in the study because the opportunity presented itself during information gathering in the research. The information gathered was used to cross check/confirm the existing knowledge.

## **RESULTS AND DISCUSSION**

### **1<sup>st</sup> Phase**

The first part of this analysis is based on interview conducted in Ministry of Roads and Transport, Ghana Highway Authority and, Urban Roads as well as 1<sup>st</sup> class financial institutions and construction companies in Ghana.

Twenty (20) Executive Officers interviewed on the question whether they have an idea on BOT, Twenty (20) officers representing 100% responded 'yes' with none of them answering no. This means that all the officers interviewed have an idea on BOT and one wonders why little is being done on it.

On as to whether BOT is applicable or can perform creditably in Ghana, eighteen (18) of the respondents, representing 90% said 'yes' while only two (2) representing 10% said no. This shows that majority of the respondents were of the conviction that BOT is feasible in Ghana specifically road sector.

Twenty (20) respondents representing 100% said 'yes' on whether BOT Model can run alongside the existing Models of funding. They were also of the view that funds mobilized through BOT can augment funds from the existing Models.

The question of why road agencies fail to pave their plan or targeted length of road every year was applicable to sixteen (16) officers excluding those from the banks. All the sixteen (16) respondents representing 100% were of the view that funding is the major problem and not expertise. This means that financial constraint is a major challenge.

On the question of whether local companies were interested in investing in BOT, seven (7) respondents in five (5) companies (2 financial and 3 Construction companies) six (6) responded 'Yes' representing 75% while one (1) respondent representing 15% responded 'No'

### **2<sup>nd</sup> Phase**

#### **Case study – Accra Kumasi Road**

#### **Investment Appraisal of Accra Kumasi Road**

#### **Data on Accra- Kumasi Road**

The study examined the case of Kumasi – Accra road and did the investment appraisal,

The following information was obtained from Ghana Highway Authority

#### **Cost of Road per Kilometre:**

Paved road average construction cost – asphalt GHA institutional GH¢ 500,000

Paved roads average construction cost – Portland concrete GHA institutional GH¢850, 000

Paved roads average construction cost – BST Ghana institutional GH¢ 300, 000

Paved road average periodic maintenance cost – Asphalt Overlay GHA Institutional \$/km 110,000

The total number of vehicles that ply Kumasi – Accra road is about 73,922 with a growth rate of 1.5.

The study considered the Asphalt GHA Institutional type which is in the neighbourhood of GH¢ 500,000 as the most durable within the asphalt range.

(Source: GHA 2009)

### **Cost Analysis**

Total length of road (Accra-Kumasi) – 272km

Cost of 272km road =  $(272 \times 500000) = \text{GH¢ } 136,000,000$

It would require an amount of GH¢ **136,000,000** to construct an Asphalt GHA institutional road from Accra – Kumasi

### **Absolute Revenue**

Absolute revenue which is all revenues accrued from the sale of tickets is calculated below:

Absolute revenue was calculated using the formulae;

$AR_1 = NC \times TF \times 288 \text{ days} = \text{GH¢ } 24,196,176$  and

$AR_s = AR_1 \times GR$  where

$AR_1$  = Absolute Revenue for first year

NC = Number of cars according to groupings

TF = Toll fare

$AR_s$  = Absolute Revenue for subsequent years

GR = Growth rate of cars (1.5 and 1.3)

### **Operating Expenses (for results refer to table 10)**

The operational cost is made up of Personal Emoluments; cost of printing tickets and the construction of Toll Booth is detailed below:

Operating Expenses was calculated using the formulae;

Operational Expenses for the first year

$OE = OC + MC$

$OE_s$  = Operational Expenses for subsequent years

$OE_s = OC_s \times MC_s$

Where, OC = Operational Cost per month = PE + M = Personal Emoluments + Miscellaneous

Operational Cost for first year

$OC_1 = PE + T + TB = \text{Personal Emoluments} + \text{Ticket} + \text{Toll Booth}$

Maintenance Cost for first year

$MC_1 = PM \times L = \text{Periodic Maintenance} \times \text{Length of road}$

$OC_s$  = Operational Cost for subsequent years = PE + T = Personal Emoluments + Ticket

$MC_s$  = Maintenance Cost for subsequent years =  $MC_1 \times 20\%$  inflation rat



Table 1.4 Total operational cost

Year	Personal Emoluments (GH¢)	Tickets (GH¢)	Booth and Secretariat (GH¢)	Operational Cost (GH¢)	Maintenance Cost (GH¢)	Operating Expenses (GH¢)
1	40,000	45,312	20,000	105,312	224,400	329,712
2	48,000	67,971		115,971	269,280	385,251
3	57,600	101,955		159,555	323,136	482,691
4	69,120	152,934		222,054	387,763	609,817
5	82,944	217,398		300,324	465,316	765,640
6	99,533	344,097		443,630.00	558,379	1,002,009
7	119,439	516,147		635,586.00	670,055	1,305,641
8	143,327	774,222		917,549.00	804,066	1,721,615
9	171,993	1,161,330		1,333,323.00	964,879	2,298,202
10	206,319	1,741,998		1,948,317.00	1,157,855	3,106,172
11	247,670	2,612,997		2,860,667.00	1,389,426	4,250,093
12	297,203	3,919,494		4,216,697.00	1,667,311	5,884,008
13	356,644	5,879,241		6,235,885.00	2,000,773	8,236,658
14	427,973	8,818,860		9,246,833.00	2,400,928	11,647,761
15	513,567	13,228,290		13,741,857.00	2,881,113	16,622,970
16	616,281	19,842,435		20,458,716.00	3,457,336	23,916,052
17	739,537	29,763,654		30,503,191.00	4,148,803	34,651,994
18	887,444	44,645,481		45,532,925.00	4,978,563	50,511,488
19	1,064,933	66,968,223		68,033,156.00	5,974,276	74,007,432
20	1,277,919	100,452,336		101,730,255.00	7,169,131	108,899,386

Table 1.4.1 Net Cash Flow

Year	Absolute Revenue (GH¢)	Operating Expenses (GH¢)	Tax (GH¢)	Net Cash Flow (GH¢)
0	136,000,000			
1	24,196,176	329,712	5,966,616	17,899,848
2	36,294,264	385,251	8,977,253	26,931,760
3	54,441,396	482,691	13,489,676	40,469,029
4	81,662,094	609,817	20,263,069	60,789,208
5	122,493,141	765,640	30,431,875	91,295,626
6	183,739,712	1,002,009	45,684,426	137,053,277
7	275,609,568	1,305,641	68,575,982	205,727,945
8	413,414,352	1,721,615	102,923,184	308,769,553
9	620,121,528	2,298,202	154,455,832	463,367,495
10	930,182,292	3,106,172	231,769,030	695,307,090
11	1,395,273,438	4,250,093	347,755,836	1,043,267,509
12	2,092,910,157	5,884,008	521,756,537	1,565,269,612
13	3,139,365,235	8,236,658	782,782,144	2,348,346,433
14	4,709,047,853	11,647,761	1,174,350,023	3,523,050,069
15	7,063,571,780	16,622,970	1,761,737,203	5,285,211,608
16	10,595,357,670	23,916,052	2,642,860,405	7,928,581,214
17	15,893,036,505	34,651,994	3,964,596,128	11,893,788,383
18	23,839,554,757	50,511,488	5,947,260,817	17,841,782,452
19	35,759,332,136	74,007,432	8,921,331,176	26,763,993,528
20	53,638,998,203	108,899,386	13,382,524,704	40,147,574,113

Table 1.4.2 Accra – Kumasi Road 272km Present value

Year	Net cash flow (GH¢)	DCF	Present value (GH¢)
0	136,000,000	1.0000	(136,000,000)
1	17,899,848	0.8000	14,319,878
2	26,931,760	0.6400	17,236,326
3	40,469,029	0.5120	20,720,143
4	60,789,208	0.4096	24,899,259
5	91,295,626	0.3277	29,917,577
6	137,053,277	0.2621	35,921,664
7	205,727,945	0.2097	43,141,150
8	308,769,553	0.1678	51,811,531
9	463,367,495	0.1342	62,183,918
10	695,307,090	0.1074	74,675,982
11	1,043,267,509	0.0859	89,616,679
12	1,565,269,612	0.0687	107,534,022
13	2,348,346,433	0.0550	129,159,054
14	3,523,050,069	0.0440	155,014,203
15	5,285,211,608	0.0352	186,039,449
16	7,928,581,214	0.0281	222,793,132
17	11,893,788,383	0.0225	267,610,239
18	17,841,782,452	0.0180	321,152,084
19	26,763,993,528	0.0144	385,401,507
20	40,147,574,113	0.0115	461,697,102
			$\Sigma=2,700,844,898$

Net Cash Flow (Ref to the Table 11)

$NCF = AR_1 - OE_1 - TX$  where NCF = Net Cash Flow and TX= Tax

$TX = AR_1 - OE_1 \times RT$  where RT= Rate of Tax

Present Value (Ref to Table 12 above)

$PV = NCF \times DF$

$$DF = \frac{1}{(1+0.25)^n}$$

Where n = 25%

Payback which is the period, usually expressed in years which shows the number of years for the initial investment to be recouped is shown below:

The conventional Payback method period was used since it takes care of the time value of money.  $NPV = PV \text{ of cash inflows} - \text{Initial Investment}$

$$\begin{aligned} \text{Payback Period} &= 5 + \frac{28,906,817}{35,921,664} \\ &= 5.80 \text{ years} \\ &= 5 \text{ years } 10 \text{ months} \end{aligned}$$

The above implies that it will take about 6 years for the initial investment to be gained. All other things being equal the project carries a least risk since it involves a shorter period during which the capital is put at risk.

### **Net Present Value**

NPV= PV of cash inflows – Initial Investment

$$= \text{GH¢ } 2,700,844,898 - \text{GH¢ } 136,000,000.00$$

$$= \text{GH¢ } 2,564,844,898.00$$

Since the present value of cash inflows is greater than the initial investment it therefore means that the project is profitable by about GH¢ 2,600,000,000.00

### **2<sup>nd</sup> Case Study (Berekum – Kumasi)**

The same method was applied to analyze a 160 km Berekum – Kumasi road as a second case study. It was realized after the exercise that the payback period would be within 10 years. This second exercise was carried out on a less busy road as a check towards the viability of BOT on some of the Major roads that are less busy as compared to the Kumasi – Accra road.

### **3<sup>rd</sup> Phase**

Accidental sampling was carried on drivers plying Accra – Kumasi and Berekum-Kumasi roads. In all, 200 drivers, 100 each on each road were interviewed. On the Accra – Kumasi road out of the hundred interviewed, 80 drivers representing 80% expressed their willingness to pay even higher toll if an excellent road is built but 20 drivers representing 20% disagreed. However, 100 drivers interviewed on the same question on Berekum- Kumasi road, 60% agreed, 25% disagreed and 15% failed to respond on the above question. This confirms the results obtained by the print and electronic media just after the recent upward adjustments of the toll fares in Ghana.

## **CONCLUSIONS**

It is not a hidden fact that the country's Highway and Urban Roads cannot be adequately maintained to highest standards. This situation has led to the country's periodic maintenance deficit now at 63.4% and the development of road deficit at 84.6%. These deficits make it clear that the models used by the Government of Ghana to solve her infrastructure development had not considerably solved the problem. Therefore not until BOT is given the needed attention to augment the existing models it will be very difficult for governments to bridge the demand and supply gap in the road sector in Ghana.

It is clear from the interview and analysis that, not because Ghanaians were poor and cannot pay tolls and other Build-Operate and Transfer (BOT) charges but government is yet to create an enabling environment to make the Build-Operate and Transfer (BOT) come into fruition. There is therefore the need for government to come out with a comprehensive policy and regulations on Build-Operate and Transfer (BOT) as pertained in other countries to promote public acceptance.

From analysis it was deduced that BOT Model is one of the best options that can complement existing financial Models to accelerate road development in Ghana especially with the oil find.

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# INVESTIGATIONS INTO THE POZZOLANIC ACTIVITIES OF VOLCANIC DEPOSITS FROM THE JOS PLATEAU: INTERIM REPORT ON CHEMICAL CHARACTERISTICS

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The costs of concrete mixtures are high in developing countries such as Nigeria due to the soaring costs of the Ordinary Portland Cement (OPC). But this can be palliated by reductions of the cement contents in the concretes mixtures by utilising natural pozzolanas as partial replacements. The investigations are therefore aimed at ascertaining the pozzolanic activities of the volcanic deposits from Jos Plateau for partial replacements with ordinary Portland cement in the concretes mixtures. The study involves the determination of the physical and chemical characteristics of the volcanic materials. The chemical tests have been conducted by means of the Energy Dispersive X-Ray Fluorescence (EDXRF) techniques. The findings show that the sum of the oxides of silica, aluminium and iron are over 76% by weight in all the materials samples tested. The results also show that the materials are free from carbon and alkalis; the sulphur and calcium contents are found to be low with values of 2% and 0.28% respectively. It is concluded from the chemical analysis that the volcanic materials are potential pozzolanas with good Pozzolanic Activity (Reactivity). The physical investigations under study would provide the levels of the partial replacements of the materials with the OPC for the production of Portland Pozzolana Cement.

Keywords: natural pozzolana, partial replacement, blended cement, and volcanic rock.

## BACKGROUND

An enormous gap exists between production and demand in Nigeria. According to Thisday News Paper (2008), the demand of cement in the country is about 18 million tons annually while local production varies from 6 to 6.5 million tons. Some of the problems faced by the cement manufacturers according to the Raw Materials and Development Council (2001) are soaring energy costs and poor infrastructures. Thus 11.5 million tons are imported yearly to meet this deficit. Consequently the costs of concretes and other cement products are high. There is a need therefore to reduce the cement content in our concrete mixtures. This can be achieved by the use of Supplementary Cementitious Materials (SCMs) of volcanic origin called Natural Pozzolanas. It is economical using the Natural Pozzolana as little or no energy inputs are required before their applications. Yilmaz (2003) stated that utilising the volcanic deposits to supplement or substituting the Ordinary Portland Cement (OPC) for the production of Blended Cement yields major benefits in terms of cost of production, enhancing the durability and long term strength of concretes. The Natural Pozzolanas

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thus, provide a ray of opportunities for the production of blended cement. What is needed are the investigations into their pozzolanic activity by the determination of the chemical and physical characteristics of the volcanic deposits

This is an Interim Report on the Chemical Characteristics of the Jos Plateau Volcanic Deposits. The chemical characteristics are the first indications as to the nature of the volcanic rocks and their possible reactivity as pozzolanic materials. The pozzolanicity of the volcanic material is the degree of the chemical reactions of the materials with calcium hydroxide at ordinary temperature to form cementitious compounds (Neville, 1981). The study is accordingly aimed at investigating the chemical characteristics of the volcanic deposits for the production of Blended Cement or for partial replacement of the OPC in concretes mixtures. The objects of the study consequently are to determine the major mineral oxides of Silica ( $\text{SiO}_2$ ), Iron ( $\text{Fe}_2\text{O}_3$ ) and Alumina ( $\text{Al}_2\text{O}_3$ ); the minor oxides of Calcium ( $\text{CaO}$ ), Sulphate, ( $\text{SO}_3$ ), Magnesium ( $\text{MgO}$ ) and Manganese ( $\text{Mn}_2\text{O}_3$ ); alkalis and other trace elements. The Lost on Ignition (LOI) and the Moisture Contents (MC) of the respective materials are also to be determined.

Mehelcic (2003) stated that the use of natural pozzolanas began in prehistoric times but were abandoned for Western based Portland Cements in the early 1900's due to market strategy rather than cost. But today, Researchers in Europe, United State of America, China and India have re-introduced these pozzolans as Supplementary Cementitious Materials (SCMs) in concrete mixtures. Neuwald (2004) classified the SCMs either as hydraulic or pozzolanic, based on the type of reactions they exhibit; the hydraulic materials such as slags react directly with water to form cementitious compounds while pozzolanic materials react chemically with calcium hydroxides in the presence of moisture to form compounds possessing cementitious properties.

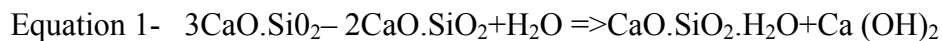
The word pozzolan, according to Jackson (2003) is derived from the Latin words pulvis Puteolamus (meaning powder from Puteoli). This was an earlier reference to the unconsolidated pyroclastic (ash) deposits around Campi flegrei and Vesuvius volcanic fields. But today, ASTM(1993) defined pozzolans as siliceous or siliceous and aluminous materials, which in themselves possess little or no cementitious values but in finely divided form and in the presence of moisture, react chemically with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties. Detwiler (1996) group the pozzolanas as artificial or natural pozzolanas. The Artificial Pozzolanas are residues of waste products of an Industrial Manufacturing Process such as fly and rice husk ashes. Natural Pozzolans are products of volcanic activities such as volcanic ash and volcanic lavas.

The Natural Pozzolans are used as partial replacements of the OPC in concrete mixtures principally for economic benefits. As reported by Detwiler (1996), the major economic advantage offered by cement blending is that same amount of cement or cement clinker can be used to significantly increase the capacity of a cement production plant(50-100%) without the installation of a new kiln. Another advantage is the energy and fuel savings. The average energy cost in the manufacturing of one ton of cement according to the European Commission (2001) is about 50% of the total cost of production. However approximately half a ton of  $\text{CO}_2$  is released to the atmosphere by the burning fuel for every ton of cement produced? Thus the benefits of cement blending not only the savings in fuel and energy consumptions but also reductions in  $\text{CO}_2$  emissions into the atmosphere.

## UNIQUE CHARACTERISTICS OF NATURAL POZZOLAN

According to Neville (1981), the chemical composition of a typical Ordinary Portland Cement is lime ( $\text{CaO}$ )-62%, Silicate ( $\text{SiO}_2$ )-22%, and Alumina ( $\text{Al}_2\text{O}_3$ )-5%. Others elements are Calcium sulphate ( $\text{CaSO}_4$ )-4%, Iron Oxide ( $\text{Fe}_2\text{O}_3$ )-3%, Magnesia ( $\text{MgO}$ )-2%, Sulphite ( $\text{SO}_3$ )-1% and alkalis-1%. Jackson (2003) highlighted that in modern Ordinary Portland Cement Production the calcinations of the lime stones ( $\text{CaCO}_3$ ) are carried out at about  $1500^\circ\text{C}$ ; a mixture of tri-calcium silicate ( $3\text{CaO}.\text{SiO}_2$ ), di-calcium silicate ( $2\text{CaO}.\text{SiO}_2$ ) and tri-calcium aluminates ( $3\text{CaO}.\text{Al}_2\text{O}_3$ ) and tetra-calcium aluminoferrites ( $4\text{CaO}.\text{Al}_2\text{O}_3.\text{Fe}_2\text{O}_3$ ) is produced. Gypsum ( $\text{CaSO}_4.2\text{H}_2\text{O}$ ) is then added for the preservation the Cement. But with the volcanic pozzolanas the raw ingredients reactivity occurs naturally from the molten earth. The Natural Pozzolans chemistry therefore differs from deposit to deposit depending on the nature and type of eruptions.

In cement hydration Neivile (1981) stated that when calcium silicate and water mixed, calcium hydroxides  $\{\text{CaO}.\text{SiO}_2.\text{H}_2\text{O}$  and  $\text{Ca}(\text{OH})_2\}$  are produced (Equation 1). Addition of a pozzolan to the mixture, a gel of a cementitious substance of Calcium-Silicate-Hydrate (C-S-H) is formed (Equation 2).



This reaction is referred to as the Pozzolanic Reaction of the pozzolan. The reaction in Equation 2 continues to produce additional C-S-H. This continuous reactivity of the OPC with the pozzolan is termed the Pozzolanic Activity of the pozzolana.

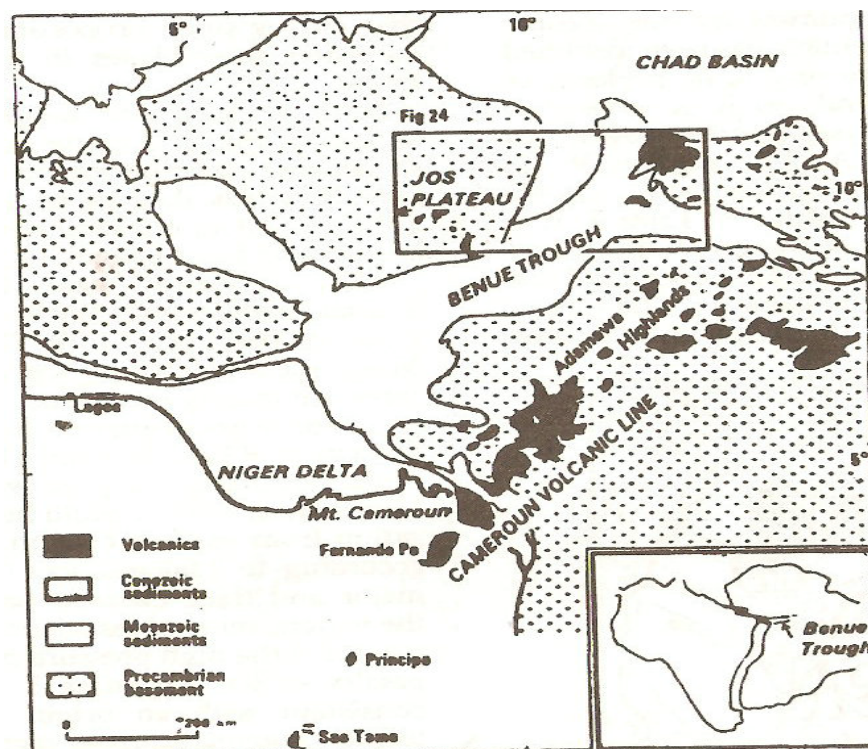


Plate 1 Showing the Benue Trough

Source: Wright (1975) *Volcanic Rocks in Nigeria*, In: Kogbe, C. A. (Ed), *Geology of Nigeria*

## RESEARCH METHODS

Wright (1975) reported that the Jos Plateau Volcanic Region is one of the major volcanic formations in Nigeria and it is situated within the Benue Trough (Plate.1); it is made up of volcanic deposits of complex rock formations with standing land marks of the volcanic features. According to Olowolafe (2000) the Jos Plateau located in central Nigeria has a wide surface area of about 9,400 km<sup>2</sup>. These volcanic deposits are substantial quantities and are prospective potential pozzolanas. The materials used for the investigations were excavated from twenty (20) different volcanic sites from the study area for the study.

### THE ENERGY DISPERSIVE X-RAY FLUORESCENCE (EDXRF) METHOD

The determination of the oxides of SiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>, Al<sub>2</sub>O<sub>3</sub>, MgO, CaO, SO<sub>3</sub>, TiO<sub>2</sub>, Na<sub>2</sub>O, Mn<sub>2</sub>O<sub>3</sub>, CrO, Y<sub>2</sub>O<sub>3</sub>, and SrO were carried out by the use of Energy Dispersive X-Ray Fluorescence EDXRF Method of chemical analysis at the Centre for Energy Research and Training (CERT) Samaru, Ahmadu Bello University, Zaria. These techniques are well developed at used by the Centre.

The EDXRF system consists of an excitation source of annular 25mCi <sup>109</sup>Cd with a Si (Li) detector coupled to a computer controlled ADC card. According Omotola (2009) the EDXRF technique provides one of the simplest, most accurate and economic analytical methods for the determination of the oxides of glass, ceramics and building materials; it is none-destructive and reliable for solids, liquids and powdered samples analysis.

In preparing the materials for the investigations; the samples were grounded manually to powder with an agate mortar and pestle to grain size of less than 125µm. Pellets of 19mm diameter were prepared with 0.5g of the powdered materials. Three drops of organic liquid binder were applied and pressed afterwards with a 10 tons hydraulic press. The pellets of each of the samples were then introduced into the x-ray fluorescence generator for the analysis.

The annular 25mCi <sup>109</sup>Cd with a Si(Li) detector source emits Ag-K X-ray (22.1keV) in which all elements with lower characteristic excitation energies were accessible for detection in the samples. The measurement of the elements was performed using the Excitation Source.

Quantitatively analysis of the samples was carried out using the Emission-Transmission (E-T) method. This method involved the use of pure target material of Molybdenum (Mo) as a target material to measure the absorption factors in the samples. The Mo target served as the source of monochromatic X-rays, which were excited through the samples by primary radiation (fluorescent) and then penetrated the samples on the way to the detector. In this way the spectra for the samples were collected and evaluated using the AXIL-QXAS program source. The quantification of the concentration of the elements was subsequently determined for the oxides of SiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub>, Al<sub>2</sub>O<sub>3</sub>, MgO, CaO, SO<sub>3</sub>, TiO<sub>2</sub>, Na<sub>2</sub>O, Mn<sub>2</sub>O<sub>3</sub>, CrO, Y<sub>2</sub>O<sub>3</sub>, and SrO.

### THE DETERMINATION OF LOSS ON IGNITION (LOI)

The Gravimetric method of analysis was used to determine the Loss on Ignition (LOI) of the materials. In this method a furnace capable of reaching a temperature of 1500°C was used. The materials were placed in a porcelain crucible and were fired at 950°C



for a period of 1hr after which they are cooled in a silica gel desicator and the weight losses of the samples were subsequently measured.

## THE DETERMINATION OF MOISTURE CONTENT (MC)

The Moisture Content MC test is similar to that of the LOI.

The Gravimetric method of analysis was also used to determine the moisture content of the samples were placed and dried in the Oven at 105<sup>0</sup>C and the weight loss was subsequently measured. The calculated value of the Moisture Contents is subsequently measured.

## RESULTS AND DISCUSIONS

### CHEMICAL COMPOSITIONS (OXIDES) OF JOS PLATEAU VOLCANIC DEPOSITS

Table 1(a) Major elements oxides of Jos Volcanic Rocks

Compounds	JP1	JP3	JP4	JP5	JP6	JP8	JP9	JP10	JP12	JP13
SiO <sub>2</sub>	29.30	68.20	29.40	52.50	34.30	51.10	32.40	37.00	16.80	51.80
Al <sub>2</sub> O <sub>3</sub>	25.80	20.13	25.76	13.19	19.38	20.25	20.51	29.75	19.13	23.25
Fe <sub>2</sub> O <sub>3</sub>	21.36	4.98	21.96	25.15	29.16	14.17	30.54	9.78	48.12	8.18
Total	76.46	92.31	77.17	90.84	82.84	85.52	83.45	76.53	84.05	83.23

Table 1(b) Major elements oxides of Jos volcanic rocks

Compounds	JP14	JP15	JP16	JP17	JP19	JP23	JP25	JP28	JP29	JP31
SiO <sub>2</sub>	32.50	23.30	38.90	24.50	19.20	26.50	20.60	63.80	33.80	27.70
Al <sub>2</sub> O <sub>3</sub>	28.88	21.75	29.63	21.01	20.88	23.25	18.88	25.38	21.88	18.38
Fe <sub>2</sub> O <sub>3</sub>	20.36	38.14	8.17	38.74	41.93	29.96	48.12	25.35	22.37	29.96
Total	81.74	83.19	76.70	84.25	81.63	79.71	87.60	82.53	78.05	76.04

Table 2(a) Minor and trace elements oxides of Jos Volcanic Rocks

Compounds	JP1	JP3	JP4	JP5	JP6	JP8	JP9	JP10	JP12	JP13
MgO	3.43	1.71	1.11	1.71	0.80	ND	ND	0.81	ND	1.11
K <sub>2</sub> O <sub>2</sub>	ND	ND	ND	ND	1.80	ND	ND	ND	ND	ND
CaO	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
SO <sub>3</sub>	0.45	0.48	0.14	0.07	ND	0.27	0.76	0.07	ND	0.21
Mn <sub>2</sub> O <sub>3</sub>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Na <sub>2</sub> O	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CO <sub>2</sub>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TiO <sub>2</sub>	1.40	ND	1.80	ND	1.80	1.5	1.20	0.60	1.40	ND
Y <sub>2</sub> O <sub>3</sub>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SrO	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CrO	ND	ND	ND	ND	0.19	ND	ND	ND	ND	ND
Total	5.56	2.47	1.53	2.06	1.99	2.05	1.75	1.76	1.68	1.68

The results of the chemical analysis (Table.1) indicated that the sum of the main oxides of silica, aluminum and iron vary from 76.04 to 92.31% of the samples tested.

This satisfied the minimum recommendation of 70% by the ASTM C (1993). Detwiler (1996) reported that silica and aluminium give the pozzolana the acidic character the great affinity to lime and alkalis. ECO-CARE Education (2005) also stated that silica as well impacts strengths while alumina controls the quick settings of cements. Further more Practical Action Organization (2005) stressed that iron contributes also to the strength, hardness and colour of the cement. The results showed the materials tested have potential pozzolanicity due to the substantial presence of the main oxides of silica, aluminium and iron.

Table 2(b) Minor elements oxides of Jos Volcanic Rocks

Compounds	JP14	JP15	JP16	JP17	JP19	JP23	JP25	JP28	JP29	JP31
MgO	1.51	1.71	2.20	0.81	0.91	0.91	2.02	1.92	1.31	1.01
K <sub>2</sub> O <sub>2</sub>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CaO	0.28	0.28	0.28	0.28	0.26	ND	ND	ND	0.28	0.28
SO <sub>3</sub>	0.21	ND	ND	ND	0.41	0.48	1.99	0.21	0.34	0.96
Mn <sub>2</sub> O <sub>3</sub>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Na <sub>2</sub> O	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CO <sub>2</sub>	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TiO <sub>2</sub>	1.00	ND	1.60	1.20	1.00	ND	0.50	2.50	ND	ND
Y <sub>2</sub> O <sub>3</sub>	ND	0.11	ND	ND	ND	ND	ND	ND	ND	ND
SrO	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
CrO	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total	3.00	2.10	5.88	2.29	2.58	1.39	4.51	4.63	1.93	2.25

The results (Table 2) of the oxides composition of the minor and trace elements of the tests of the samples studied showed that the oxides the sum of oxides varied from 1.39 to 5.88% of the materials investigated. ASTM (1993) sum of these oxides should not be more than 5% by weight.

The alkalis of sodium and potassium (Na<sub>2</sub>O and K<sub>2</sub>O) values from the study are very insignificant. Sodium was not traced in any of the samples. ASTM C 618 recommended 1.5%. While Potassium was detected in only 5% of the samples tested. Na<sub>2</sub>O value not exceeding 0.6% is considered to be alkali free. These alkalis react with some aggregates in the surrounding cement paste with cause's expansion of cement. This expansion not only causes cracks but slows down the rate of gain of strength in concrete production (Neville, 1981). This shows that the materials under investigation are good for the application as Supplementary Cementitious Materials for concrete mixtures.

Another important finding in this study is that in all the materials studied, there was no trace of carbon. This reflects one of the major characteristics of Natural Pozzolana discovered by Azmar (2000). Lava Mining and Quarrying International Company (2005) based on is experience on the Pagan Island of the opinion that the carbon content of a natural pozzolana should not be more than 1% by weight.

The volcanic materials tested indicated that magnesium oxide varying from zero to 3% by weight. Auden (1950) recommended 4% as the maximum limits of MgO. The excess of these oxides may cause unsoundness in cement as reported by Neville and Brooks (1994).

Sulphur trio oxide (SO<sub>3</sub>) presence in the volcanic rocks tested ranged from 0% to 2%. ASTM C 618 recommended 3% maximum value by weight. Little amount of sulphur

contributes to the soundness of cement, while excess of it makes the cement unsound and leads to the destruction of concrete.

### LOST ON IGNITION (LOI)

Table 3(a) Lost on Ignition (LOI)

ID	JP1	JP3	JP4	JP5	JP6	JP8	JP9	JP10	JP12	JP13
LOI	13.0	14.0	13.0	7.0	11.0	10.0	12.0	17.0	13.0	8.0

Table 3(b) Lost on Ignition (LOI)

ID	JP14	JP15	JP16	JP17	JP19	JP23	JP25	JP28	JP29	JP30
LOI	13.0	12.0	17.0	12.0	8.0	16.0	11.0	14.0	12.0	10.0

The results of test (Table.3) indicate that the LOI for samples are between 8% and 14%. Three samples (15%) had their values reaching 17% of the materials by weight. Practical Action (2005) recommends that Lost on Ignition LOI should not be more than 15%. LOI could indicate the extent of hydration and carbonation of free lime and magnesia in the materials.

### MOISTURE CONTENTS (MC)

Table 3(a) Moisture Contents (MC)

ID	JP1	JP3	JP4	JP5	JP6	JP8	JP9	JP10	JP12	JP13
MC	0.1	0.2	0.3	1.2	0.3	0.8	0.10	0.1	0.30	0.50

Table 3(b) Moisture Content

ID	JP14	JP15	JP16	JP17	JP19	JP23	JP25	JP28	JP29	JP30
MC	0.50	0.10	0.20	0.30	0.20	1.80	0.30	0.50	0.60	0.60

The result of the moisture content (Table.3) showed the highest value of the MC is 1.8%. This is within the ASTM (1993) recommendation of 3% maximum for pozzolanas.

### CONCLUSION AND RECOMMENDATION

It is concluded from the chemical analysis that the Jos Plateau Volcanic Rocks are potential pozzolanic materials for partial replacement of Ordinary Portland Cement in concrete mixtures. It is thus recommended that the physical and mechanical investigations be studied to provide the levels of partial replacements of the OPC with these materials.

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# LAND AND HOUSING VALUES AND THEIR EFFECT ON HOUSING DELIVERY IN SEKONDI-TAKORADI METROPOLIS, GHANA

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A study was conducted to find out the land and houses values, the relationship between the two variables and to ascertain their effect on housing delivery in Sekondi-Takoradi Metropolis. This paper adopted both quantitative and qualitative research approach to seek information from developers, landlords, and landowners and land administrator in nine selected communities in Sekondi-Takoradi Metropolis through questionnaire survey. A questionnaire survey was used in data collection. In all, a total of 120 questionnaires were distributed. 65 valid responses out of the total number were received at the end of a two week period representing a response rate of 54.2%. It emerged from the study that the land and houses values in well developed residential areas were respectively about four and three times higher than the less developed residential areas classified as third class residential areas. In this study it was also discovered that the average house values in first and second class areas were twice the land values, while, the average houses values in the third class areas were three times their corresponding land values. It was also discovered that the slow rate of housing delivery in the metropolis is due not only to the high cost of land but also other land related factors. The research recommended that the Sekondi-Takoradi Metropolitan Assembly and the utility service providers should provide the necessary utilities in the third class residential areas to enhance delivery of houses in these areas which would at the same time ease the population density on well developed areas.

Keywords: Ghana, house value, land value, Sekondi-Takoradi.

## INTRODUCTION

Housing is an important issue which has a tremendous impact on the socio-economic development of every nation. It is very important in any economy and provides security to societies, communities and families. The declaration at the first United Nations centre for Human Settlement Conference (Habitat I) held in 1976 in Vancouver, Canada, expressed the commitments of Government the world over to address the problems of housing and human development. This was reiterated at the Habitat II conference in Istanbul, Turkey in 1996. The Istanbul declaration, among others, endorsed the universal goal of ensuring adequate shelter for all and making settlement safer and more conducive for human habitation.

Ghana like many other developing countries is facing an acute housing problem. Whereas the country's population is increasing at the rate of 2.7 per annum, the

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increase in housing stock is unable to keep pace and the situation is worsening (Ghana Statistical Service, 2000).

The annual housing requirement is estimated between 110,000 and 140,000 units but current housing delivery is about 30,000 units per annum, (Local Government Information Digest, 1999).

The building industry has so far failed to provide enough shelter for the populace. It has been universally accepted that shelter is the second most essential need after food (Ghana Housing Policy 1991). Unfortunately, this essential need is not readily available to many people in Sekondi-Takoradi Metropolis.

Rapid population growth and increasing urbanization coupled with continuous flow of people from the hinterland to the twin city in search of non-existing jobs have led to overcrowding, increased homelessness and overstressed of existing infrastructures and services in the metropolis. Most residents in the twin city encounter serious accommodation problems as they desperately look for decent and reasonably priced houses to rent. The reason being that the population in Sekondi-Takoradi outnumbers the houses available, and this has resulted in increased slumps in the metropolis.

This research aims at determining the land and houses values, find out the relationship between land and house values and find out factors effecting housing delivery in Sekondi Takoradi Metropolis.

According to Burns and Greble (1977), the social and community services include the presence of schools, hospitals, markets, playgrounds water supply and waste disposal facilities within the neighbourhood. Housing may be referred to as adequate housing if the essential components of housing that is, shelter (i.e. physical protection from the elements and intruders), privacy and security, domestic facilities, environmental amenities and social and community services are met. According to Osborne (1985), the adequacy and the performance requirements of a residential property can be assessed in terms of appearance durability, dimensional stability, strength and stability, weather exclusion, sound control, thermal comfort, fire protection, lighting and ventilation sanitation, security and cost.

## **BACKGROUND OF STUDY AREA**

Sekondi-Takoradi known as the twin city is a gateway to the west coast and is located in the south-western part of Ghana, about 218 km to the west of Accra, and has an area of 334.33 km<sup>2</sup>. It is the administrative capital of the Western Region. The Twin City is linked by rail and road to Accra and Kumasi; the two largest cities in the country. Sekondi-Takoradi which was originally two separate towns lying just few kilometres apart was combined in 1946 into a twin city. Sekondi is a mixture of old and new buildings on a hilly site, extending to the seashore. Takoradi is a well-planned city with modern buildings and tree-shaded residential areas. In 1928 a harbour was built at Takoradi which made the city the most important commercial town in the country until the opening of the Tema Harbour in 1961. Prior to the opening of the Tema Harbour and when a Ghana railway was fully functioning, there was migration of people all over the country to Sekondi-Takoradi which brought on a cultural and tribal diversity to the area. The metropolis experiences an equatorial type of climate with high temperatures ranging from 22°C to 33°C.

## **Housing situation in Ghana**

One of the challenges that confront Government today is the housing of our ever-growing population. The shortage of housing grew considerably worse during the intercensal period 1970-1984. According to the 1984 population census, the occupied housing stock was over 1.2 million units; the population of the country was 12.3 million persons, implying a ratio of population to housing units of 10.1 with little improvement in amenities and other infrastructural services in housing stock.

The outcome of the studies carried out by the National programme for Economic Development in 1997 concluded that, the stock of housing in the country was not increasing whilst the population continued to grow putting considerable pressure on the availability and affordability of housing. Whereas in the rural areas the housing problem is that of shortage of quality housing, in the urban areas the shortage is both qualitative and quantitative. The continuous flow of people from the hinterland to the cities in search of non-excising jobs has led to overcrowding, growing homelessness and overloading of existing infrastructure and services in the urban centres.

According to Ghana News Today, the scale and complicity of the housing problems in the urban areas of Ghana are intensifying; Accra is in the midst of an accommodation crisis, as house and land prices are spiraling out of control and even middle class Ghanaians cannot afford to own a home (Ghana News Today, 22 January 2007). According to the Ministry of Works and Housing, there is insufficient housing in the urban areas. Recent estimates range from absolute shortages of 400,000-500,000 units of housing nationwide. It is further estimated that to replace this short fall national housing delivery should be between 120,000-175,000 housing a year, however, the current supply capacity is only 30,000-40,000 units per year. Thus, 60 percent of the national requirement remains unfulfilled each year.

### **Affordability of housing in Ghana**

Affordability is the ability to pay for housing. Affordability looks at whether the form, technology and cost of housing are compatible with income flow of the prospective consumer of housing. Affordable housing is a dwelling where the total housing is affordable to those living in that housing unit.

According to the United Nations Global Report on Human settlements the cost of a complete dwelling could be 2.5 to 6 times the average annual salary (Okpala et al 2006). Household income is usually allocated to a number of competing uses such as food, cloth education, health care, transportation and all other needs necessary to maintain a good and healthy life of the household within a given Socio-economics and cultural environment

Rent costs vary across urban and rural regions in Ghana. The Estimated average cost of rent in Accra is between sixty and hundred Ghana cedis per two bed room facility a month, which is approximately \$80-\$20.20. Therefore, based on the foregoing figures, the average household could be paying rent costs in Accra that exceed the household's annual income especially where payment of rent is demanded from one to five years advanced by Land Lords. The African Union for Housing Finance has reported that demand for housing is significantly higher in the major cities of the country. The shortage in housing stock poses a major barrier to affordable and accessible housing in Ghana.

## **PUBLIC POLICY RESPONSE TO THE HOUSING PROBLEMS**

The right to housing has never been considered a critical issue in Ghana's development framework. This as a result has brought about a series of fragmented policies rather than a holistic and comprehensive vision to deal with the complexities of housing since independence.

Various attempts have been made by the Government in the past to resolve the problem of housing through the promotion of low cost housing projects, Creation of State agencies, building societies, and roof and wall protection loan schemes among others. Successive Government intervention and response to housing problem in the past was geared towards direct state delivery of housing units. The policy on housing at the time was centralized with subsidy packages made available to increase ownership of houses in the country by giving loans from the public coffers to people to build houses: thus over 10,000 government bungalows, quarters and residences were built in this way.

Government also instituted the Roof Loans Schemes Funded from public coffers to assist rural people to rehabilitate or complete their houses. However, with changing economic fortunes and in view of the huge capital outlay, it became increasingly clear that such direct intervention methods were neither viable nor sustainable in the long term. Government also find that this approach tended to neglect development of the private sector, which account for about 80% of the country's housing supply. However, with changes in administration came changes in the role of the state in housing policy. Government's role has now changed from direct provider to that of facilitator and enabler to assisting the private sector to increase its output. The facilitation role is in the form of promoting greater access to finance, land with good title, and provision of necessary regulatory framework to guide development, provision of adequate incentives for investors in the housing sector and technical support and training. The liberalization of the housing sector led to the conversion of The State Housing Corporation to a limited liability Company and the creation of The Ghana Real Estate Developers Association (GREDA) and the Home Finance Company (HCF). There is the need for government to evolve policies and take measures that will strengthen institutions like Land Commission, Town and Country Planning and Rent Control division in collaboration with land owners to improve the housing stock in the Sekondi-Takoradi Metropolis.

## **INCOME AND ACCESS TO THE LAND MARKET**

Current land prices in Accra prohibit about 65 percent of the population from entering the housing market. Land values, for instance, in East Legon, a suburb in the capital, are between \$40,000 to \$60,000 per residential plot with serviced lands in Tema selling for about \$15,000 to \$18,000 per plot. In Kumasi, the second largest city, urban land prices range from \$20,000 to \$40,000 for unserviced lands close to major road networks (Mahama, 2004). The high cost of housing is caused by the price of land and high cost of utilities such as roads, water and electricity on such lands. The majority of Ghanaians spend more that 40% of their income on housing.

More than half of Ghanaians live on less than \$1 per day. A study conducted in 2004 in three urban cities, namely Accra, Kumasi and Tamale, showed that less than 5% of people living in these areas could comfortably service loans of about 50 million cedis in a ten year repayment period (Mahama, 2004). This was in 2003. More recent evidence suggests that the situation has gone from bad to worse. The authors till now



have not found any literature on land values in Sekondi-Takoradi Metropolis, hence research on land and housing values in Sekondi Takoradi Metropolis.

## RESEARCH METHOD

Combination of quantitative and qualitative research methodology was used in this research. Data obtained for this research was limited to developer, landlords, and landowner in nine selected communities in Sekondi-Takoradi metropolis through questionnaire survey. The communities are Beach Road, Chapel Hill, Airport Ridge, Anagyi, Namibia, Palm Lands, Race course Ridge, Asakae, and Mpatadu. The questionnaire was design on initial literature review on land and housing situation in Ghana. In order to evaluate the clarity and how respondents were going to answer the questions, a pilot survey was conducted. The pilot survey was sent to eight professionals in Land and housing administration of which four were returned within five days, representing a response rate of 50%. No major changes were made to the questions after the pilot survey before officially administering the questionnaire. In all, a total of 120 questionnaires were distributed. 65 valid responses out of the total number were received at the end of a four week period representing a response rate of 54.2%. The questionnaire had five sets of questions:

1. *Respondent characteristics:* Demographics on the respondent's professional background, organization'
2. *Land values:* -issue relating to price of land, location,
3. *Housing prices* —issue relating to house prices, housing type, location
4. *Relation between housing and land values.*
5. *Issues relating to Housing delivery*

## DATA PRESENTATION AND ANALYSIS

Table 2 represent average values of land and houses in the nine selected communities. The selected communities were divided into three groups namely first, second and third class residential areas. Figure1 gives the graphical presentations of average land and housing values in the three groups of residential areas.

In all, four questionnaires were received from officials of four government Agencies namely: Land Commission, Land Valuation Board, Town and Country planning and State Housing Company of Ghana (SHC) as initial pilot survey. The data from the pilot survey was not for analysis purposes but rather it was used to check the clarity of the questionnaire. 65 valid responses out of 120 questionnaires were received from developers, landlords and land owners.

The five set of questions outlined in the questionnaire gave the respondents the opportunity to:

1. Give their profession and to tick whether they are landlords landowners or developers who are developing to sell, let or live in
2. State the cost of land in the area, the owners of the land, and to express their views on the acquisition of the land.
3. Give indication on how much various type of houses are sold in the area, how much do they intend to sell their houses if they are to do so and whether they would like to sell their buildings. Respondents were allowed to state if the type of question was not applicable to them.
4. Express their views on factors affecting the delivery of houses in the metropolis.

The results from the received questionnaires are recorded in Table 1.

Table 1 records the details of received questionnaires

Class of residential area	Questionnaires received	Type of respondents (Landlord (completed houses))	Developers to incomplete houses)		(Land owners
			Sell	Own	
First	15	11	2	2	0
Second	22	18	0	4	0
Third	18	8	3	6	1

Table 2 Land and houses average values in nine selected areas in STMA

Communities	Class of community	Average Land values per acre Gh¢	Average Housing values Gh¢		
			2 bed room flat	3 bed room flat	4 bed room flat
Beach Road	First	65,000.00	80,000.00	120,000.00	150,000.00
Chapel Hill	First	52,000.00	70,000.00	100,000.00	140,000.00
Air Port Ridge	First	32,000.00	60,000.00	80,000.00	130,000.00
Average values	First	49,667.00	70,000.00	100,000.00	140,000.00
Race Course Ridge	Second	22,000.00	35,000.00	50,000.00	70,000.00
Anaji	Second	25,000.00	40,000.00	50,000.00	70,000.00
Namibia	Second	26,000.00	35,000.00	50,000.00	70,000.00
Average values	Second	25,000.00	36,666.00	50,000.00	70,000.00
Asakae	Third	12,000.00	20,000.00	30,000.00	45,000.00
Palm lands	Third	14,000.00	25,000.00	30,000.00	50,000.00
Mpatadu	Third	10,000.00	18,000.00	30,000.00	40,000.00
Average values	Third	12,000.00	21,000.00	30,000.00	45,000.00



Figure 1: Bar chart of average land and house values in nine selected communities in STMA

## LAND VALUES IN SEKONDI-TAKORADI METROPOLIS

The data in Table 2 and the graph presentation in Figure1 indicated that land the average values in first class areas were two times and four times higher than average land values in second and third class residential areas respectively. The second class communities have average land price twice higher than that of the third class communities.

The major reason for this trend in the land values is that the first class areas have better social amenities like roads, water, electricity and other utility services than the second class areas which in turn are also better than the third class areas. It was also observed during the research that the first class areas are quiet and environmentally cleaner than the other communities. Additionally, there is no litigation on any of the plots of land in the first class residential areas. On the other hand, the plots of land in the second and third class areas are characterized by a high state of land encroachment, multiple sales of land by individuals, chiefs and families.

On a question ‘‘who owns the plots of land you are developing?’’ The respondents in the first class areas answered that the land is under the direct custodian of the Government. The second and third class residential areas have their land owned by private individuals.

## **HOUSING VALUES IN SEKONDI-TAKORADI METROPOLIS**

From the responses to the questions which are recorded in Table 2 and also represented graphically in Figure 1, it was noted that for the same type of housing unit the average prices of houses in first class residential areas were two times and about three times that of second and third class residential areas respectively. Similarly, the average values for houses in second class residential areas were 1.3 times that of the third class residential areas.

On the issue of whether they would like to sell their houses. Most landlords answered no, with the exception of two respondents in the third class residential areas, but no reasons were assigned though they were given the opportunity to give reasons for the choice of answer.

## **HOUSE AND LAND VALUE RELATIONSHIP**

This section of the study analyses the relation between land and house prices using the research data. From Table 2 it was clear that for first and second class residential areas, the house values were about 1.5, 2.0 and 2.8 times the land values for two, three and four bedrooms respectively. However the relationship between houses and land values were higher for third class residential areas. The house/land values relationship was about 1.8, 2.5 and 3.8 for two, three and four bedrooms respectively. It is therefore clear that the prices of houses do not depend only of the land price but also on other factors. The next section would look at the factors, other than land, that might influence the delivery and price of houses.

## **FACTORS AFFECTING THE HOUSING DELIVERY AND PRICE**

The last part of the questionnaire asked the respondents to express their views on why housing delivery is not marching the population growth especially in Sekondi-Takoradi metropolis. Below are summary of their responses. This question was designed to seek the opinion of respondents on factors that might affect housing delivery in Sekondi-Takoradi.

It was indicated that, the major challenges facing the housing delivery in Sekondi-Takoradi Metropolis were the acquisition of land, rapid population growth and cost of building materials and labour. The respondents were given the opportunity to explain further. The summary of the explanations are as follows:

### **Acquisition of land**

The high cost of land was cited as one of the major factors affecting housing delivery in the metropolis. The price of land is factored into the price of housing which makes the cost of housing very expensive. Most of the respondents, particularly, those in the third class residential areas also said that the complex nature of land tenure system and many land disputes among Land Lords in the metropolis poses a big challenge in the provision of affordable houses.

### **Population growth**

Whereas the region's population is increasing at the rate of 3.2 per annum, the rate of population growth in Sekondi-Takoradi metropolis is about 4.2 per annum, as evidence in Ghana Statistical services records. This situation makes it difficult for provision of housing to meet the demand for it.

### **Cost of building materials and labour**

All the respondents in all the case study areas unanimously agreed that the major factor affecting the cost of houses in the Metropolis in particular and in Ghana as a whole is the cost of building materials and labour. They expressed their concern about the increase in prices of building materials especially cement almost every quarter of the year. According to them the prices of materials have direct relationship with the cost of labour. However, this claim could not be substantiated nor established by any of the respondents.

## **CONCLUSION**

A study was conducted on land and houses values in Sekondi-Takoradi Metropolis with the purpose of finding the relationship between the two variables and also ascertains the effect of these values on housing delivery. For both our qualitative and quantitative studies, the paper concludes that:

1. The houses values have direct relationship with land values in all classes of residential areas.
2. Although land values in the least developed areas are less expensive than that of well developed areas people prefer latter to the former. This was due to litigation, multiple sales of land and lack of utility services.

In the quantitative study it emerged that whiles, the average house values in first and second class areas were twice the land values, average houses values in the third class areas were three times their land values.

In the study, it emerged that; litigation, a high spate of land encroachment, and multiple sales of land by landowner are some of the reasons why people preferred living in the first class areas to the third class residential areas, though the cost of land and houses in the third class areas are relatively low. These characteristics most often than not result in delay of project execution, loosing of property and sometimes lost of human life. Furthermore, lack of utilities services in the third and second class residential areas make these areas less preferred according to the research findings. The shortage of housing in the Metropolis has grown considerably worse in recent years. This was also attributed to the acquisition of land, rapid population growth and cost of building materials and labour.

It was evident in the study that the land values in the third class areas are relatively low. In order to add value and also to encourage developers to go there, it is recommended that the Sekondi Takoradi Metropolitan Assembly and the utility service providers, should provide the necessary utilities in the third class residential areas to enhance delivery of houses in these areas, which would intend ease the tension on well developed areas.

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# MANAGEMENT OF WATER DISTRIBUTION INFRASTRUCTURE WITH GIS IN THE NIGER DELTA REGION OF NIGERIA

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Water is essential for man's existence and without it, there would be no life on earth. The total water consumption is on the increase due to the increase in population and civilization. Water is regarded as a resource that should be well planned, developed, conserved, distributed and managed. Its infrastructures should be properly maintained to avoid future water problems. Drastic changes are needed in the collection, distribution and management of water infrastructure. These challenges and the threatening water crises have continued to demand innovation and state - of- the - art technology. This paper examines the use of Geospatial Information System (GIS) in the location, planning and maintenance management of water distribution infrastructure. The use of Global Positioning System (GPS) derived data for the creation of water distribution infrastructure (DWI) management database is discussed. Data generated from University of Benin Teaching Hospital (UBTH) water distribution network were used to generate case study scenario. The results of the study revealed that with the provision of accurate, up-to date geospatial information about the components of UBTH water supply systems, their physical location above, on or beneath the earth's surface can be easily determined. Besides, dynamic water distribution system maps which reflect the current position of the components of the water system on the earth's surface and are sine qua non for effective planning, design, development and maintenance management of water distribution network can be produced from either Computer Aided Design (CAD) or GIS environment using the up-dated geospatial information (coordinates). The study further revealed that UBTH water distribution system is not only poorly maintained and funded but is also in the wear out period of the Bathtub Hazard curve whose hazard rate increases with time. Moreover, the frequent leakages and pipe burst in the study area can be attributed to the fact that most of the water system components are old and have outlived their designed life. The study has provided vector model (UBTH Water supply scheme) not only for pinpointing the location of the components of the water supply system but also for locating those components of the water system that are either malfunctioning or have outlived their design life and would need repair or renovation or replacement. The developed GIS for UBTH water supply scheme is capable of displaying the water system inventory, graphically present the modelling output, able to identify a good location for the water system facility site as well as perform system spatial analysis, answering questions about the locations of any components of the water system. The developed GIS can also be used to obtain complete and accurate digital mapping inventory of the water network.

Keywords: water distribution infrastructure, Geospatial Information System, maintenance management, Global Positioning System, Computer Aided Design.

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## **INTRODUCTION**

The maintenance management of infrastructure, especially engineering infrastructure, is not only a topical issue in the underdeveloped and developing nations of the World but also in the advanced (industrialized) nations of the World. Constant damages to facilities or interruption of services by forces of nature and human activities are crying for changes in techniques and technology for managing our infrastructure hence the need for the modern information system which is computer-based (Onibokun, 1997). Many water systems are aging, leaking, and breaking at rate not matched by the pipe rehabilitation or replacement cycles. In a period of severe economic regression characterized by under-valued naira, and extremely high cost of goods and services, the call for maintenance management and technology still sound to many like a “distance early warning” but its need is indeed immediate (Obiegbu, 2002). It is only through effective maintenance management that a water utility can fulfil its responsibility to provide safe, good – quality water to the community it serves. Without the appropriate level of care, an asset eventually deteriorates to become a liability over time. This is not acceptable in so vital a resource as water systems.

A major challenge in the water industry in Nigeria, which has affected rehabilitation and maintenance management of water distribution infrastructure, is the problem of location, identification and geo-spatially positioning of buried water distribution infrastructure. The as-built plans or record drawings which document the water infrastructure or systems as they were laid beneath the earth’s surface and are sine qua non for their monitoring and maintenance management were rarely produced. The few available water supply schemes are not properly kept nor updated. This is a major problem not only to this present generation but shall also be for posterity to locate the water infrastructure that had been laid beneath the surface of the earth several years ago.

Geo-spatial information system (GIS) is capable of revealing important information about the water distribution infrastructure data, spatial patterns and relationships, modelling and analysis. Geo-spatial information system is a valuable management tool for water distribution modelling not only as a source for modelling data and as a decision- support tool but also an essential basic ingredient for physical planning, design, development and maintenance of water distribution infrastructure. If a GIS is used as the foundation for building a water model and the GIS is maintained in the long term, the water model can be rebuilt easily in the future using up-to-date GIS data (Walski et al, 2003).

## **STATEMENT OF THE PROBLEM**

Population explosion, urbanization, industrialization and civilization with increase in water consumption, over exploitation and poor water management world-wide are adding greater pressure on the limited fresh water resources of the World. According to Cullen (2005), “a modern society has been victim of its own success. A higher quality of life has meant greater demands on our services as people use more water and burn more energy. Data collection and distribution, however, has not moved on”. These challenges and threatening water crises have continued to demand innovation and state- of- the- art technology needed for drastic changes in the collection, distribution and management of water.

Rehabilitation of aging water distribution systems is a major infrastructure concern of the water industry in underdeveloped, developing and developed nations of the world.



The developed Countries have taken pragmatic steps towards increasing their investment on their aging water infrastructures. Poor maintenance culture of engineering infrastructure especially buried water distribution pipes is a major problem in many developing nations of the world. According to Agunwamba (2000), lack of preventive maintenance and absence of institutional framework and trained personnel for adequate maintenance of water schemes have contributed to non sustainability of schemes. The existing water supply infrastructures in use today in many cities of Nigeria are aged with some being more than 100 years old (Alavi, 1984) and the situation is further deteriorating due to lack of funds and poor maintenance (Bukar, 1992 and Izinyon, 2007). The technological advancement in the nation, which has led to tremendous growth in water distribution system, has not been translated to improved water supply as private boreholes with little or no treatment abound, water borne diseases are on the increase and low pressures are evident in many states of the nation (Izinyon, 2007).

## **AIMS AND OBJECTIVES**

The main aim of this study is to carry out an engineering evaluation of the location and maintenance management of University of Benin Teaching Hospital (UBTH) water distribution infrastructure in GIS environment. The specific objectives are to: examine the location of University of Benin Teaching Hospital water distribution infrastructure (WDI) laid beneath the earth's surface since they are spatial in nature; carry out a complete survey with state-of-the-art instruments in order to acquire their geospatial and attribute data in digital format which are a sine qua non for determining their spatial distribution and spatial analysis using GIS software; generate data and information on the water distribution infrastructure including the state-of-art management information which will help to manage the WDI datasets with GIS and hence create a database of WDI in GIS environment; investigate the existing maintenance management in place for the sustainability of the water distribution infrastructure in the study area, and to construct water distribution infrastructure model (Water supply scheme) for UBTH.

## **COMPONENTS OF WATER DISTRIBUTION SYSTEM**

The distribution components form a large proportion of total investment in any water supply system (Rao, 2002). Water distribution system account for 40-70% of the total cost of water supply scheme (Sarbu and Borza, 1997 and Izinyon, 2007), hence its proper planning, design, operation and layout is of great importance. Water distribution network contains all the various components of a water system and defines how the components are interconnected. These components include water reservoir, water pipes, water pumps, storage tanks, junctions and valves. According to Lansey and Mays (2000), a water distribution system consists of three major components: distribution piping network, pumps and distribution storage.

## **MAINTENANCE MANAGEMENT OF WATER UTILITY**

Water utilities must manage their infrastructures the best way they can so as to meet the challenges of population explosion and civilisation (Graham, 2002). Inadequate maintenance has been the failure of infrastructure providers. For example, water supply systems deliver on average of 48% of their output to users, compared with best practice delivery rate of 85% (Obiegbo, 2002). Poor maintenance reduces service quality and increases the costs to users, some of whom install back-up generators or water storage tanks and private wells/ boreholes at great cost. In a period of severe

economic regression characterized by under-valued naira, extremely high cost of goods and services, the call for maintenance management and technology still sound to many like a “distance early warning” but its need is indeed immediate (Obiegbu, 2002). Only through effective maintenance management can a utility fulfil its responsibility to provide good water to the community it serves (Jordan, 2000).

## **GEO-SPATIAL (GEOGRAPHIC) INFORMATION SYSTEM (GIS) AND ITS REVELANCE TO THE MANAGEMENT OF ENGINEERING INFRASTRUCTURE**

Just as information and communication technologies (ICT) have a strong effect on many aspects of our personal lives, and business, so have they created a turning point in the way we manage our geographically referenced information. Cities, countries and utilities worldwide are turning to computerised Geo-spatial information system (GIS) to automate everything from simple mapping functions to complex land-use analysis, site selection and network modelling requirements. GIS has not only created a new dimension in map making, it has opened new frontiers in the ability to make more sound, more enlightened decisions about the very foundation of how we plan and manage our cities, natural resources, land holdings and utility distribution systems (Smyrnew, 1990). According to Parker (1996), “about 85% of all information has some spatial content. All information with spatial reference can be brought together by GIS for comparison and analysis.”

The unprecedented ability of GIS to integrate all kinds of information makes it a valuable tool for planning, design, construction and management of infrastructures (Ehiorobo, 2002). Computer Aided Design (CAD) and Geo-spatial Information System (GIS) are the most valued tools for the development and management of engineering infrastructure. According to Dangermond (2010), “GIS continues to evolve and be applied to many complex problems around the world. The technology itself plays three main roles – as an application platform technology for geospatial applications, as an information management system for geospatial content and as a framework for integrating many different types of geographic information”.

The two basic data models that GIS uses in representing GIS data for both abstractions are vector and raster. Vector data models represent geographic phenomena with points, lines, and polygons. A raster model, otherwise known as a raster dataset (image), in its simplest, is a matrix (grid) of cells (ESRI, 2000). A widely used GIS software, Arcview and ArcGIS, stores vector data in feature classes and collection of topologically related feature classes. The attributes associated with the features are stored in data tables (ESRI, 2000).

## **RESEARCH METHOD**

**Data acquisition:** The geo-spatial data of the water distribution infrastructure components was acquired with the state-of – the art instrument, Global Positioning System (GPS) receivers. The positioning of the water distribution infrastructure components and existing significant infrastructures on the earth surface was carried out by the method of Differential GPS (DGPS) using CFG 113B as a reference point. The accuracy for their positioning was less than 50cm. The attribute (descriptive) data of the water distribution infrastructure which included among others, pipe size, material, age, maintenance condition and leakage control method, and appurtenances were acquired through the use of a standard pro-forma specially design for the study.

The standard pro-forma contains the inventory and condition survey of the water distribution network of the study area.

**Data processing:** The post processing of the GPS data was carried out with INCA GEOMETRIX software. The software made it possible to transform GPS data in the World Geodetic System 1984 (WGS'84) observed in geographic co-ordinates to plane rectangular co-ordinates using Minna Datum of Nigeria. Moreover, all the attribute data acquired from the field work were extracted from the standard Pro-forma, and a text file was generated with the help of Microsoft Excel.

**Data Modelling:** The modelling of the geospatial information of the water distribution network of the study area was carried out with Computer Aided Design software (AutoCAD). The text file of the coordinates was exported into AutoCAD software, which was used for pre modelling of the WDI components of the UBTH Water Supply Scheme. Since the WDI components are vector data (points, lines and polygons), they were therefore modelled in the CAD software as vector model. Thereafter, the vector model was edited and quality assurance test carried out on the system, which addresses key issues such as connectivity, completeness of the data captured and the accuracy of the position of the water distribution infrastructure. The CAD model was saved in drawing interchange files (DXF).

**CAD Model and GIS integration:** The CAD drawing file (dxf) of WDI components for UBTH water supply scheme was exported to Arcview GIS. The Cad layer was converted to shapefiles (.shp). Shapefiles are simple, non topological format for storing geometric location and attribute information of geographic features.

**Design and Creation of Spatial Database System for WDI components of the study area in GIS environment:** In this study, a single database system was employed. The attribute data of WDI components for the study area were designed and added to the themes of the shapefiles. Aliases were created for the field names so as to make the fields names more meaningful. The attribute information was typed directly into the themes of the attribute tables as records. This information can be symbolised, queried and displayed on the screen. Besides, the information can be updated regularly since Arcview GIS has the capability to automatically update all the themes in the view that are based on the same CAD drawings.

## RESULTS AND DISCUSSION

The coordinates and some attribute information of the components of University of Benin Teaching Hospital (UBTH) Water Distribution Network (WDN) are presented in Table 1, and Table 2 shows the information of the existing state of the maintenance management of WDI in the waterworks. UBTH water supply scheme together with the location of burst pipes in GIS environment is presented in Fig. 1.

Table 1 Coordinates and attribute information of the components of University of Benin teaching Hospital (UBTH) Water Distribution Network (WDN)

Location Description	WDN Component	Label	Coordinates		Status	Capacity
			N (m)	E (m)		
Central pumping station(CPS), back of Engineering Dept.	Borehole	BH <sub>1</sub>	264219.985	354201.995	Operating	22.38kw
Inside Nursing hostel	Borehole	BH <sub>6</sub>	264688.021	354183.022	Operating	1.492kw
Opposite the entrance gate to UBTH from the road to Anatomy gate	Sluice valve	SV <sub>2</sub>	264404.987	354281.969	Functioning	-
Along M.I. Ogbeide way, beside the Golf course	Sluice valve	SV <sub>5</sub>	264312.032	354744.033	Functioning	-
UBTH exit gate to Anatomy road	Air valve	AV <sub>1</sub>	264395.010	354251.992	Functioning	-
Beside Obstetrics and Gynaecology Ward	Air valve	AV <sub>2</sub>	264300.000	353988.000	Functioning	-
Inside Nursing Hostel	Elevated storage tank	EST <sub>2</sub>	264682.090	354192.840	Functioning	16 m <sup>3</sup>
Junction of F.G.A Cole way, Off Anatomy road	Burst 100 mm AC Pipe	BP <sub>1</sub>	264462.040	354260.920	Replaced with 100mm AC pipe	-
Road opposite the staff club, Off Ogbeide way	Burst 75mm AC Pipe	BP <sub>2</sub>	264524.140	355382.940	Replaced with 75mm AC pipe	-

Table 2. Existing state of the maintenance management of WDI in the waterworks

S/N	ITEM	UBTH Waterworks
1	Availability of maintenance Dept, manager and programme	Yes
2	The effectiveness of the Maintenance Programme	Fair
3	Type of maintenance practices in place for the water supply scheme	Break down Maintenance
4	Keeping of up-to-date inventory of the components of the WDI	No
5	Computerisation of the maintenance Dept and her activities	No.
6	Documentation of the maintenance records	No
7	Boreholes maintenance condition/ frequency	Good/Annually
8	Maintenance procedure for the entire water system	Contract Award
9	Pipelines maintenance condition/frequency	Fair/Irregular
10	The Population the water scheme served as at 31 <sup>st</sup> March 2009	218,708
11	Leak Control Method	Passive Leakage Control and Pressure Control
12	Causes of frequent leakages and pipe burst	Poor funding, poor maintenance and the components of the WDI have outlived their design life.

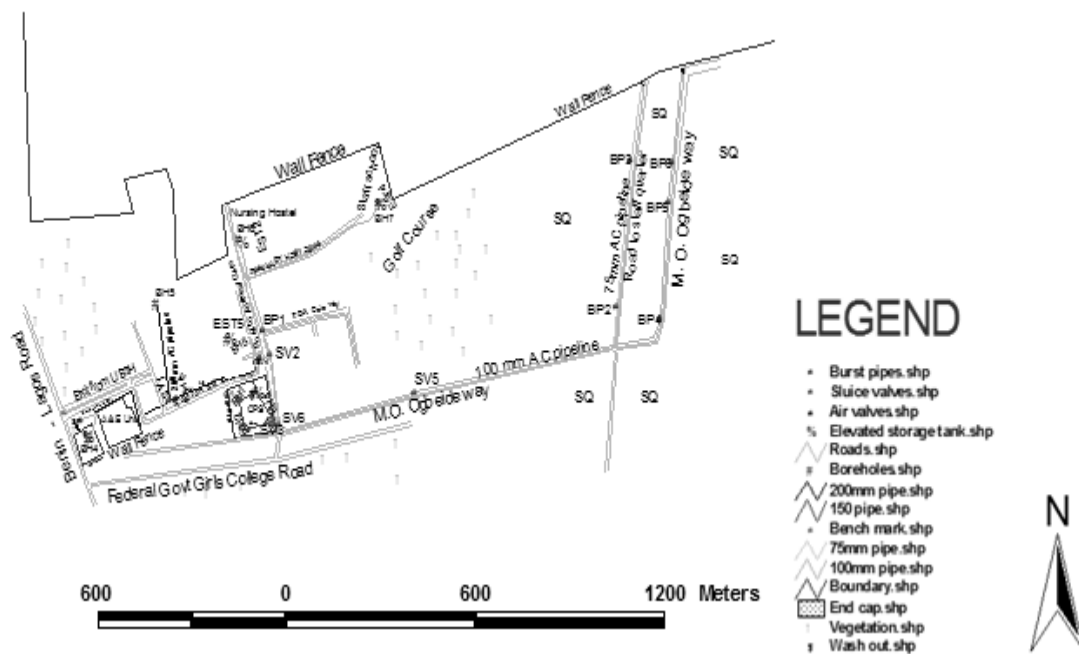


Fig. 1 University of Benin Teaching Hospital water supply scheme in GIS environment

The rectangular coordinates are the most convenient and most used method of describing the positions of engineering infrastructures such as highways, buildings, power-lines and waterlines, etc on, beneath or above the surface of the earth since these infrastructures are spatial objects. The water supply scheme of the study area can be located, planned, designed, constructed and maintained on the basis of the computerised information, which includes coordinates as well as other information concerning topography, geology, drainage, population among others. The locations of UBTH water distribution systems components can be determined and modelled on the water distribution system maps with the help of the coordinates and Spatial Information System software such Computer Aided Design (CAD) software and GIS software.

The study has revealed that there is inadequate knowledge of the location of the water distribution systems laid beneath the earth in the study area due to non-availability of accurate and up-date geospatial information about the water distribution network such as the water distribution system maps, as-built plans etc. Since only the older workers who were in the waterworks when the water distribution network was laid know its location, and there are no available up-to-date, documented records that will assist the younger staff, it therefore means that the death or transfer or resignation of such staff is detrimental to the corporation and for the future generation. With the provision of accurate, up-to-date geospatial information (coordinates) about the components of UBTH water supply system, their physical location above, on or beneath the earth's surface can be easily determined. This is a panacea to the location of water distribution infrastructure laid underneath the surface of the earth.

Furthermore, with the help of the modern geomatics (surveying) techniques and state-of-the-art instruments such as Electronic Total Station (ETS), the Global Positioning

System receivers and satellite remote sensors, regular updating of the geospatial information of the components of the water systems can be carried out. This is very important for maintenance and maintainability purposes. Dynamic water distribution system maps which reflect the current position of the components of the water systems at the desired scales can be produced from GIS environment using the coordinates acquired with the instruments. Since regular up-dating of water distribution system maps is inevitable due to increasing population, urbanization and industrialization, the updated geospatial information using the above instruments can be easily modelled in CAD environment using CAD software and exported to GIS environment for GIS modelling and spatial analysis.

The UBTH water supply system (Fig.1) shown in GIS environment as vector model will not only aid in locating and maintaining the components of water distribution infrastructure in the study area but also help to identify those system components that are malfunctioning such as pipe breaks, leakages, aging and valve failures. The water supply schemes and the as-built records of the study area will foster effective planning and maintenance management of the schemes. Leakages, which are perhaps the single most worrisome problem peculiar to water distribution networks that finally lead to burst, are examined in this study. The location of the burst pipes in the water supply scheme is shown in Fig.1. The frequent leakages and pipe burst along the distribution network are caused by old age, poor funding, poor maintenance and that most water systems' components have outlived their design life.

The irregular and break down maintenance shown in Table 2 as a normal mode of operation in the study area is unacceptable in so vital a resource as water systems. Most components of the water supply scheme are in the third region, the wear - out period, of Bathtub hazard curve, whose hazard rate increases with time. This, therefore, calls for urgent rehabilitation exercise in order for the waterworks to provide sustainable, potable water to their consumers. Lack of maintenance' records of the existing WDI leads to poor maintenance of water infrastructure. The result of the failure mode and effects analysis method of maintenance analysis tools employed in this study shows that the failure modes are the pipe leakages and burst etc. The failure causes are poor maintenance, old age and poor funding of the water system infrastructure. The failure effects are waste of potable water; waste of considerable amount of money; creation of artificial and acute shortage of water in the system; environmental pollution and untold hardship to the consumers.

## **CONCLUSION**

The significance of accurate and up-to-date geospatial information in the planning, location, design and maintenance management of water distribution infrastructure in GIS environment has been highlighted. The study has provided a good databank for UBTH water supply system which is essential for the production of water distribution system maps, and vector model (Water supply scheme) not only for pinpointing the location of the components of the water supply system but also for locating those components of the water system that are either malfunctioning or have outlived their design life and would need repair or renovation or replacement.

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# MULTI-CRITERIA DECISION MAKING MODEL FOR CONTRACTOR SELECTION IN CONSTRUCTION PROJECTS IN NIGERIA

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Selection of contractors is a crucial decision taken by the client and his representatives in order to ensure the project is completed within time, cost and quality standard. It has plagued the construction industry in Nigeria and has led to corruption, delay and abandonment of projects, despite government intervention “due process” set up by the government of Nigeria for the purpose of transparency and accountability in public sector. The purpose of this research is thus to examine the selection processes and to form a model that will serve as a standard method for selecting competent contractors. The research intends to cover Lagos state and the Federal Capital Territory of Nigeria and the study via questionnaire survey would investigate contractor’s perspective to the selection process and the methods used by the clients’ organization and consultant in selecting contractors. Data to be collected would be analyzed using descriptive and inferential analysis. The study will enable client and consultant in choosing a competent contractor and the model will aid the consultant in decision making so as not to be subjective in their decision.

Keywords: contractor selection, decision model, performance, prequalification, tendering.

## INTRODUCTION

The existence of a large number of contractors in a limited number of projects and uncertainty in constructions industry environment results in intensive competition between contractors (Ritz, 1994). However, the contractor selection which is a system of selecting competent contractor and negotiating the contracts have to be addressed at the early stage of any construction programme (Holt, Olomolaiye and Harris, 1996). The decision make by the client or his representative directly or indirectly affect the success or otherwise of a project outcome (Holt, 1996). Thus, a wrong approach in selection could lead to project failure. The client is therefore faced with choosing between using competitive bidding and negotiation to select contractors (Waara, 2006). Most client organizations adopt a selective approach for inviting tenderers for construction projects. This help to prevent contractor default and associated overhead costs of contractors. It enables the clients to assess the liability, competency and capability of potential contractors to satisfactorily carryout the contract. It also minimizes the potential risk involved in the project (Ng and Skitmore, 1999). Odeyinka and Yusuf (1997) note that wrong tendering practices is a major contributor to inefficiency in Nigeria construction industry. Current selection methods are faced with inherent weaknesses which adversely affect the performance of construction projects (Aje, 2008). In addition, there have been steady increase in the range of

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methods used for procurement of construction works in the last two decades for instance in Nigeria we have “Due process which is meant for transparency and accountability, but yet there have not be improvement in the success rate of construction projects. However, most projects have lead to abandonment of projects, delays, substandard work, cost overruns, insolvency of contractors with ultimate liquidation and conflicts between parties (Ogunsanmi and Bamisile, 1997). Koskela (2000) cited in Aje (2008), project management is faced with many problems and so a better means of managing project delivery is therefore necessary for construction industry to continue to survive. Therefore the method of ensuring that a contractor is able to execute the assigned project in accordance to client’s objectives (time, cost and quality standard) is to assess the contractor’s capabilities at the prequalification and tender evaluation stages (Hatush and Skitmore, 1997). Prequalification is a pre-tender process used to investigate and access the capabilities of contractors to carry out a contract satisfactorily should it be awarded to them (Odusanmi, 2003; Russell et al, 1992; Hatush and Skitmore 1997). It entails a given set of criteria which determines the competence and ability to perform the work if awarded the contract. These criterions are set of principles laid down, upon which the standard of acceptance and performance are measured (Oyediran, 1995). Therefore multi-criteria decision methods provide a comprehensive set of qualitative and competitive criteria that help to justify tender selection decisions (Holt et al, 1995). And so prequalification is a saving grace which assists unsuspecting clients from falling prey into the hand of incompetent contractor (Drew and Skitmore, 1993). The tender evaluation stage is the final selection stage and according to Ogunsanmi and Bamisile (1997) this is based on competition and negotiation. By competition, it implies that open and selective methods are used. This also involves screening of contractors and examinations of competency of the contractors in order to prevent the project from being awarded to an inappropriate contractor. Contractors prequalification and tender evaluations are therefore, decision making processes that occur within the overall procurement strategy. This study therefore intent to form a model to enable a competent and experience contractor to be selected for a proposed project by any client organization. The model will incorporate all relevant criteria simultaneously for the selection of the most appropriate contractor for the proposed project and also aid in decision making.

## **STUDY OBJECTIVES**

1. To identify and assess the criteria for contractor selection in some selected client organization at both prequalification and tender evaluation stage.
2. To assess contractor perceptions on contractor selection during pre-qualification and tender evaluation.

## **HYPOTHESES**

In order to further examine the objectives for this study, the following hypotheses are postulated:

1. There is no significant relationship on contractor pre-qualification criteria and project performances (cost, time and quality standard)
2. There is no significant difference between client criteria and contractor perception on contractor selection.
3. There is no significant relationship on tender evaluation and project performance (cost, time and quality standard).

## CONTRACTOR SELECTION

Contractor selection is one of the main decisions made by the client. It is a decisive event for project success (Alarcon and Mourgues, 2002). It corresponds to the interface between varieties of construction industry clients as a result the success or failure of the project depends on the interface, because it is the magnifying glass used to look for the contractor who satisfies the project objectives (Fong and Choi, 2000). It is a cushion procedure to be taken by the client and his representative's. Contractor selection is much like a miniproject; it needs a project management approach. This means that a total project management approach to the planning, organizing and controlling of the selection effort is necessary (Ritz, 1994). The challenging paradigm of contractor selection policies indicates the shift to include consideration of responsiveness, responsibility and competency (Palaneeswaran, Kuwaraswamy and Tam, 1999). Construction project is a high risk venture which the client must be able to manage, but selecting an incompetent contractor may magnify the problems encountered in the project (McCabe, Tran and Ramani, 2005; Odusami, 1998). The selection of qualified contractor therefore will give the client assurance that the selected contractor can achieved the project objective (El – sawalhi, Eaton and Rustoon, 2007 cited in Aje, 2008). Regardless of the procurement system, the task of selecting contractor has to be addressed at the early stage of the construction programme (Holt, Olomolaiye and Harris, 1994). The selection process should identify a contractor, whom the client can trust to execute the project satisfactorily (Holt, et al 1995). The correct choice of the competent contractor is a function of either the client's consultant or the project manager (Kumaraswamy, 1996). This function required appraisal of current workload and resource capacities of the contractors (Hatush and Skitmore, 1997). Contractor selection involves a procurement system which comprises five common processes. They are project packaging, invitation, prequalification, short listing and bid / tender evaluation (Hatush, 1996; Hatush and Skitmore, 1997; Cheug and Li, 2004) while Thomas and Smith (1994) cited in Diekman (1980) identified four strategies used to qualify contractors. They are prequalification, post qualification, contractors bonds and contractor licensing. According to Ogunsanmi and Bamisile (1997) and Odusami (1998) contractor selection can be view form two prospective. They are prequalification (pre-selection) and tender evaluation (final selection stages. This study also intends to view contractor selection from the prospective of these researchers.

Prequalification is the screening of construction contractors by client or his representatives according to a set of criteria deemed necessary for successful project performance, in order to determine the contractor's competence or ability to participate in the project bid (Moore, 1985; Clough, 1986; Odusami, 1998; Bubshait and Al-Gobali, 1996; Ng and Skitmore, 1999; Stephen, 1984). It is also a commonly used process for identifying a pool of competitive, competent and capable contractors from which tenders may be sought (Lam, Hu and Ng, 2005). Russell and Skibniewski (1988) opined that the actual process of contractor prequalification has received little attention in the past. They describe the contractor prequalification process along with the decision making strategies and the factors that influence the process. The process entails dimensional weighing, two –step prequalification, dimension-wide strategy, prequalification formula and subjective judgment. These processes are importance for competent contractors to be eligible for the tender. At this stage, the ineligible contractors would have been eliminated. Prequalification is a decision making exercise that involves input from various parties (Russell and Skibniewski, 1988 in

Khosrowshahi, 1999). The criteria are set up by the decision unit within the client organization. These criteria differ from one organization to the other. The criteria used to evaluate the contractors are financial stability managerial capability, Technical capability, Health and safety, Contractor reputation and image (Jennings and Holt, 1998). Yusif and Odeyinka (2000) identified other factors other than price; they are technical ability, financial base, relationship with client consultant and past performance among others. While Seeley (1984) assess prequalification criteria as contractor's reputation, financial stability, adequacy of resources, scope of work normally undertaken by contractor's availability to do the job, cooperation and price level.

Criteria used in the prequalification process should also included review of the credentials and experience of the various design/supervision. Consultants proposed by the various contractors. In addition, subsequent tender submissions also included evaluation of a selected consultant's qualification and reputation in order to gain further assurance of professional conduct from the consultant (Al-Reshaid and Kartam, 2005). Wee (2004) is of the opinion that financial capability, technical expertise, project management capability, quality and safety management capability are the criteria for contractor prequalification. Pongpeng and Liston (2003) analyzed a common criteria to be used by government and private organization to include engineering/construction, procurement/contract, project managers, human resources, quality management systems, health and safety, plant/equipment, financial strength and public relations. Holt et al (1994) considered contractors current workload, contractors' past experience in terms of size of project completed, contractor management resource in terms of formal training regime, time of year weather, contractor past experience in terms of catchments and experience in terms of project completed.

This prequalification criterion is usually comprehensive and gives a clear picture of the contractors. Most of these contractors provide the information by sourcing for them as a document. This might be the reason most Nigeria contractors scale through the prequalification exercise (Aje, 2008). This will definitely affect the performance of the project in terms of time, cost and quality standard since the rightful data is not provided by the contractors at the prequalification stage. The above criteria of these past researchers will serve as a basic for this study. Successful evaluated contractors during the prequalification process will proceed to the tender evaluation stage. .

Below are the criteria to be used for this study:

### **Financial capability**

Financial capability of a contractor relates to bank status which gives an indication of the financial management abilities of the contractors and their relationship with a bank in case of insolvency (Aje, 2008). It determine whether the contractor will stand or fall (Russell, 1992). However, the evaluation of financial soundness shows the financial historical data so as to give the financial status of the contractor (Mangitung and Emsley, 2002). According to Hatush and Skitmore (1997), the financial status of a contractor can be assessed through the balance sheet which shows the financial position of the firm and the income statement, which measure the net result of firms' operations over a specified interval such as annually. The subcriteria of financial capability include bonding, ratio analysis, credit rating and banking arrangement.

### **Managerial capability**

Management capability of a contractor relate to the past performance and quality of work, project management organization, experience of key personnel and management knowledge (Aje, 2008). Contractor's site management system and procedures entails cost, schedule, material control and safety as the importance factors for selection of contractor (Moore, 1985). The amount of workload for a contractor must be within the contractor's resource constraints prior to invitation to tender. It includes capability to manage subcontractors, cost control procedures, material management, method of procurement and cash flow forecasting. In addition site management leads to project performance. It entails the experience of the key personnel on site (Cheung, Suen and Cheung, 2004).

### **Organization criteria**

Alarcon and Mourgues (2002) opined that quantification of a contractor's reputation and image is subjective and difficult to gauge. Contractors are evaluated base on past failures, reasons for recent debarment, reasons for failed contract, previous failures to perform contracts properly or failed to complete on time, financial penalties and termination of contract (Aje, 2008). Health and safety is a criteria for contractor prequalification in which the organisation should have health and safety policy. However, in Nigeria health and safety is not usually of paramount unlike in developed countries like UK (Wong, Holt and Harris, 2001). Even though in Nigeria, health and safety measures are part of the preliminaries items that should be priced by the contractors.

### **Experience criteria**

Experience measures the national or local catchment, type and size of past project completed (Holt et al, 1994). Therefore the geographical area of operation needs to be determined during prequalification (Aje, 2008). The availability of plant and equipment can affect the decision of clients in selecting a contractor because they are vital to construction success (Wong and Holt, 2003).

While Tendering\Bidding is the process that a contractor will undertake in order to arrive at a successful bid. The objective of tendering is to select a suitable contractor, at a proper time, and to obtain an acceptable offer to execute construction works prior to selecting a suitable tendering method (Hore, Kehoe, Mumullan and Penton, 1997). Tendering process according to Moselhi and Martinelli (1990) is composed of two different and distinct activities. The first according to them deals with preparing tender estimates is normally carried out by contractors, and it leads to the submission of tender after the adjudication process. The second activity deals with tender evaluation and is normally carried out by owners and/or their representatives (quantity surveyors and project managers) and leads to the selection of one or more contractor(s) to construct the project. In Nigeria, the use of the lowest bidder criterion is common for the contractor selection, especially on public projects. Oyediran (1995) found that price was the overriding criterion for contract award in Nigeria. Jagboro and Ogunsemi (1997) on effectiveness of cost criteria for appraising tenders found out that the lowest tender, quantity surveyor's estimate and average of contractors' tender were all reliable cost criteria for appraising tenders in Nigeria. According to Zavadskas and Vilutiene (2006) cited in Straub and Mossel (2007) says that apart from the lowest bidder, the contractors' characteristics such as financial position and past experiences should be considered. However in the UK, the Latham (1994) questioned the frequent practice of selecting the lowest tenderer. The report called for proper

consideration and weighing of a range of selection criteria to be taken into account during contractor selection. Recognising the inadequacy of the 'lowest bidder' criterion, many countries have introduced other qualifications to this criterion and established procedures for the evaluation process. This study intends to consider other criteria apart from the lowest bidder for selection of contractors.

The contracting system consists of competitive and non-competitive tendering methods. The competitive methods include open, selective tendering (Aqua group, 1987; Ayeni, 1997; and Ashworth, 1986) and the non-competitive method is nominated or negotiated. The method used depends on the nature of the projects. The selection of contractors incorporates a legal relationship between the client and the contractor. This is because different contract types have different contract documents (Ogunsemi and Ojo, 2005). Seeley (1993) opines that whatever contract arrangement is adopted, it should define the agreement of the parties in respect of design, time and cost and also provide a sound, definitive legal and administrative basis for the construction process. The main contractual relationship possible between the client and contractor according to Ramus (1982) and Wainwright and Wood (1979) is the lump sum, design and build contract and management contract. Before the client and the contractor signed the contract, the submitted tender will be scrutinized by the tender board, which consists of the client and his representative (Ramus, 1982). After the exercise, each of the tender will be notified by sending a complete list of the names and the amounts submitted by all the tenderers in alphabetical order and the tender figure in ascending order (Wainwright and Wood, 1979). It is recommended that the second lowest tender should be kept open until the lowest tenderer has been informed of the intention to accept his price and his priced bills of quantities have been examined (Ayeni, 1997). Due process guideline on opening of tenders provide that the client should correct the arithmetical errors in the tender provided such clarification and corrections of computation do not change the order of the tenderer as witnessed by the public (Aje, 2008). Mshelbwala (2005) in Aje (2008) opines that the winner of a competitive bid is that competent bidder who offers the client the lowest cost for the execution of the contract. In Nigeria under due process, the lowest bidder methodology of awarding contract is frequently used method of selecting contractors. This method has been abused by tenderers. Once they have received the mobilization fee, they either elope or lower the quality specified for the project. It therefore becomes necessary for a modification of the lowest tenderer (Hatush and Skitmore, 1998). It also tends to affect the project performance and the client bears the whole risk.

## **THEORETICAL AND CONCEPTUAL FRAMEWORK**

The theoretical framework for this study is based on the following works:

### **Model for bid evaluation using program evaluation and review technique (PERT) approach**

Hatush and Skitmore (1997) model consider the contractor and client criteria, Fig 1 below shows how the criteria may be assessed against each other. The clients investigate and assess the capabilities of all the necessary criteria based on four contractors (A, B, C, D) and how these criteria affect time, cost and quality using the PERT approach. Aggregate expected means, variances and standard deviations for time, cost and quality were calculated for all bidders for different client goals.

The criteria in the table below are usually used during prequalification to screen the contractors before the tendering stage. This study also intends to use these criterions to form it conceptual model and relate the importance on each of the criterion.

Table1: Main criteria and sub criteria for contractor prequalification and bid evaluation

Criteria	Sub criteria
Financial Soundness FS	1. Financial stability 2. Credit rating 3. Banking arrangements and bonding 4. Financial status
Technical ability TA	1. Experience 2. Plant and equipment 3. Personnel 4. Ability
Management capability MC	1. Past performance and quality 2. Project management organization 3. Experience of technical personnel 4. Management knowledge
Health and safety HS	1. Safety 2. Experience modification rating(EMR) 3. Occupational safety and health administration (OSHA) incidence rate 4. Management safety accountability
Reputation R	1. Past failure 2. Length of time in business 3. Past client/contractor relationship

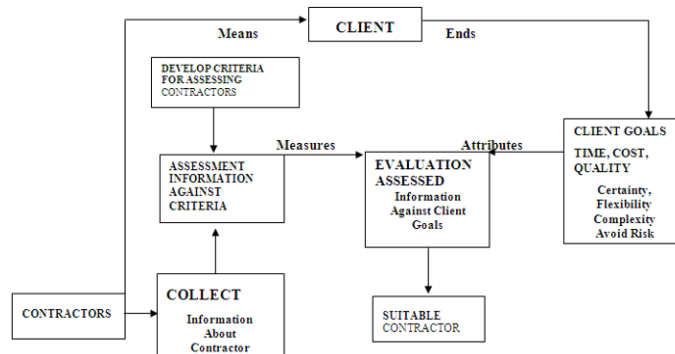


Fig.1 Model for bid evaluation using pert approach (Source: Hatush and Skitmore, 1997)

### Model for contractor selection process

Topeu (2004) consist of two main stages for contractor selection. They are:

- i. Contractor prequalification
- ii. Choice of the eligible bidder among prequalified contractors.

The major aim of the project owner is to achieve satisfaction by getting high project performance and high quality of completed construction. The “time” and “quality”

dimensions are used for prequalifying contractors while cost related to the eligible bidder as shown in fig 2.

Prequalification stage:

There are two main criteria at the prequalification stage. They are ability to timely complete projects representing the “time” dimension and organizational expertise representing the “quality” dimension. This is illustrated below in fig 3.

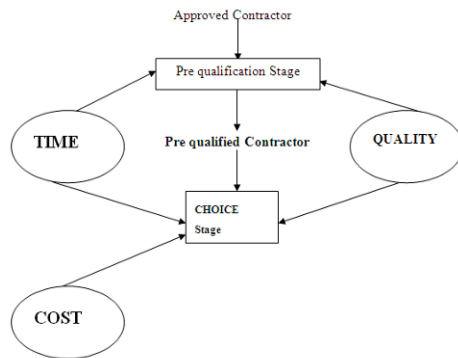
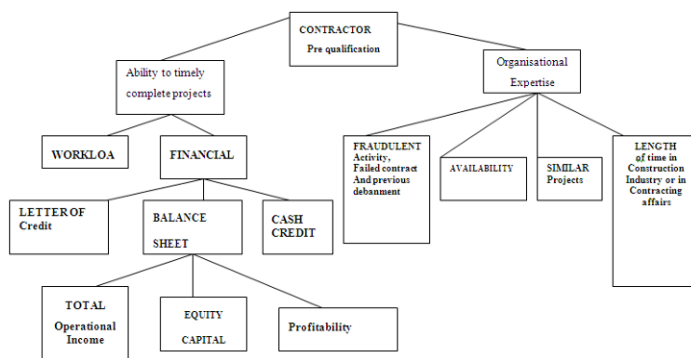


Fig 2: The main Stages for the model on contractor selection process



From fig 2, the short-listed applicants who have passed the mandatory requirements filter (MRF) represent the alternatives of the prequalification decision problem. The next step is to assess the performance values of alternatives with respect to evaluation criteria in order to construct the prequalification decision matrix.

After the decision matrix is constructed, the global prequalification scores (GPs) of the contractors are revealed by utilizing analytical hierarchy process (AHP) rating method.

The GPs of a contractor is obtained by rating in which the performance values are transformed into ratings which are between 0 and 1. Only those contractors who have passed through prequalification threshold filter (PTF) are prequalified. All contractors having GPs greater than or equal to the predefined threshold value passed.

The second stage begins with the utilization of the bid prices filter (BPF) where the bid prices offered by the prequalified contractors are evaluated by calculating the average value ( $\mu$ ) and the standard deviation value ( $\sigma$ ) of the bid prices of the prequalified contractors. Those having bid prices above thresholds are excluded he remaining contractors are referred to as feasible bidders and they represent the alternatives of bicriteria decision problem.



Using the relative weights of benefit and cost criteria, the weighted average of the normalized performances values representing the choice scores (CSs) of contractor are completed. If there is a contractor with highest GPs and lowest bid prices, its CS will be 1 point.

By sorting the CSs in descending order, the ranked list of the feasible bidders is produced. If CSs of all contractors are below a predefined threshold (e.g. 0.95) no contractors will be awarded the contract and the recommendation will be toward a new tender. If some contractors pass the filter, the contractor at the top position is recommended to the client for award of contract.

Choice threshold filter (CTF) is an optional filter for the client and in most cases it could be omitted and the contractor with highest CS is awarded the contract.

## **RESEARCH METHOD**

Research design is the structuring of systematic observation to investigate the influence of one variable or a group of variables on a given situation, condition and/or other variables (Behling, 1990). This study intend to identify the criteria for contractor selection and to investigate the impact of these criterion on project performance to form a model which aid in decision making during selection of contractors for a proposed project. Therefore a descriptive and correlation research survey is used. The population for the study entails the clients (private and public clients), consultants (Architect, Quantity Surveyors, Builders and Engineers) and the contractors. The list of the practicing professionals is obtained from the respective professional bodies from 2007 till date and those of the contractors from the government and those accredited by the Nigeria institute of Builders. Research area are Lagos state and the federal capital territory, Abuja, Nigeria. A probabilistic sampling technique would be adopted for this study. Data for the research are generated using opinion-based questionnaire survey which will serve as the primary data. The secondary data entails compilation of different prequalification criteria of various clients' organization within the research area and also getting the number of completed construction projects which follows "Due process". The data would be analyzed using descriptive and inferential statistics.

## **CONCEPTUAL FRAMEWORK**

The proposed conceptual model for this project will considered contractor selection from two perspectives in respect of other researcher such as those developed by Topeu (2004) and Hatush and Skitmore (1997). The two perspectives are prequalification and final selection stage. For prequalification the criteria to be considered are organization, financial, management, experience and past performance of the bidder. The decision makers who are the consultant and the client will screen the profile of each of the bidders and a judgment will be made in relation to the client goal. At the second stage, which is the final selection stage the consultant will considered the lowest bidder based on the tender figure submitted by those that were successful in the first stage.

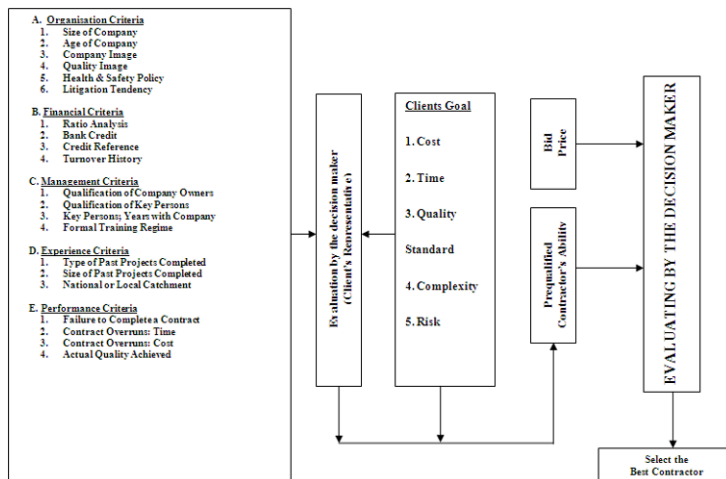


Fig 4: Conceptual framework for contractor selection

## CONCLUSION AND FURTHER RESEARCH

This study would be able to identify the criteria for various client's organization during contractor's prequalification and tender evaluation and make a comparison on the criteria and the impacts on contractor project performance in Lagos state and Abuja, Nigeria. It will enhance the project to be completed within time, budget and quality standard. The most important criterion is used as a basic for screening the contractors. The decision model developed will reduce the subjectiveness and corruption practices associated with contractor selection. It would also ensure the lowest bidder criteria is not the only key factor for criteria during tendering evaluation stage. It is believed the practical application of this model will enhance improvement thereby ensuring the selection of the most competent contractors for construction process. It is therefore hoped that this research would be an early warning sign of contractors' like hood performance to clients. It will also enhance their chances of successful tendering for new works. Furthermore, this study would assist in reducing delays, chances of substandard work, insolvency and determination of employer (clients) because the potential performance of the contractors can be determined at the inception of the project.

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# PEOPLE'S ATTITUDE TOWARD PROPERTY TAX PAYMENT IN MINNA

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This work examines people's attitude toward tax payment in Minna. Data were collected via sets of questionnaire and interview conducted in Minna, the capital of Niger state. Findings revealed that, 90.5% of the respondents pay tax generally, out of which 71.5% is personal income tax while property related taxes stood at 9.4%. Sampling people's willingness to pay tax, 41.6% are willing to pay while 52.6% are not willing to pay. Property rate is the major property tax in operation in Minna. Severance tax, site value rating, special land taxes and betterment tax are not in operation in Minna. The respondents advanced reasons for their lack of interest in paying tax to include lack of awareness, ignorance, and corrupt government officials among others. The paper recommends measures for creating positive people's attitude toward property tax payment and strengthening the existing property generated revenue with the view to accelerating development projects most especially at the local government level.

Keywords: development, property, property tax, tax, revenue.

## INTRODUCTION

Nigeria is the most populated country in Africa with more than one-seventh of the continent's estimated population and the effect of its population growth on public utilities is better imagined than describe as most of the social services and amenities have been overstretched (Aliyu, 2008). Federal, State or Local government will therefore need fund to meet the ever-increasing demand for services expected of her teeming populace. Even till now, both the State and Local governments have been relying on Federal government allocations which are dwindling and never enough to meet these needs. So, every tier of government should have alternative sources of generating revenue other than the monies available through Federal consolidated account.

Properties have been recognised as one of the most important sources of generating revenue. For instance, the governments in Kenya, Tanzania and Australia levy (site value rating) taxes on vacant land to stimulate developments (Oyegbile, 1996). Some Countries impress property taxation as one of the viable channels of managing their land policies toward equitable distribution of land while others a means of generating revenue. Also, the governments in Taiwan and Chile levy taxes on vacant lands to stimulate developments in certain zones. In Jakarta, Indonesia, the government collects higher tax rates on land not in use and the Republic of Korea taxes speculative gains in land transaction (Aliyu, 2008). Charles and Marcus (2005), have mentioned

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that property taxes account for about 75% of the state and local government tax revenues in the United State.

Most Cities in Nigeria are faced with challenges of inadequate infrastructure facilities. The available ones are overstressed. Minna, the Capital of Niger State is not an exemption. The State government realised this fact and a programme tagged “Tax Issue” comes up on the television every Sunday of a week. This has been a right step in the right direction. However, it is worrisome that much is yet to be tapped from property based taxes considering the advantages of this form of tax over others. It is against this backdrop that this study will examine the relevance of people’s attitude toward property tax payment in Minna

## **STATEMENT OF PROBLEM**

Overdependence by government on budgetary allocations as the source of revenue, by overwhelming degree, had been a recurring practice in Niger State up till this moment. At the same time, the problems militating against the successful implementation of property tax in the state are fundamental in nature and they concern procedural as well as attitudinal issues. The result is that both the state government and local government have not been able to achieve much success in mobilizing internal funds to provide facilities on regular and predictable basis.

There is still much increases in demand on public services and utilities. Efforts to meet these demands have not been matched by budgetary allocations, a situation that makes the need to raise the level of extra-budgetary funding imperative. Other alternatives have to be explored.

Property (land) is a viable alternative to complement government’s revenue base. Real property is responsive to economic growth and predictable in terms of yield. In spite of its proven potentials, property taxation in Minna remains in its infancy. This is the issue this research tends to address.

## **THEORETICAL FRAMEWORK**

### **Taxation**

Nightingale (2001), defined Taxation as the system by which a public authority imposes certain levies, rates or duties on its subjects for the purpose of raising revenue. “A Tax is compulsory contribution imposed by government, and while tax payers may receive nothing identifiable in return for their contribution, they nevertheless have the benefit of living in a relatively educated, healthy and safe society.”

Also, Okoni (2006), quoted Nightingale (2001) as she further explains that taxation is “part of the price to be paid for an organized society.

Nightingale (2001), further identified six(6) reasons for taxation which include Provision of public goods, redistribution of income and wealth, promotion of social and economic welfare as well as economic stability

In support of the public good arrangement as one of the basis for taxation, Murphy and Nagel (2002), argued that , “...The ends that may be claimed as legitimate for the state and that affect tax policy can be ranged under three headings: public goods, benefits to individual and distributive justice. Public goods are defined as those that cannot be provided to anybody unless they are provided to everybody. The obvious way of getting everyone to pay their share is through taxation, coercively imposed.

## **Property tax**

According to Franzsen (2002) as quoted by Ayoola & Adeogun (2008), Property tax, is an annual tax on the ownership (or occupation) of immovable property that is land and/or buildings), as in many countries elsewhere in the world. It is an important source of government revenue.

Ifediora (1997) as quoted by Ayoola & Adeogun (2008), said that property based tax liability is on ownership and or occupation of property and for which the value of property, rental or capital is the basis of the assessment. He also mentioned that, the person who pays the property based tax is the owner and/or the occupier of the property. He went further to say that assessment objective of property based tax is normally capital value where the tax is on the capital worth of the property as in property tax or rental value where the tax is on the annual income of property as in property/tenement rating. In line with this, achieving the objective in each case is a highly technical and complex matter requiring the skills, knowledge, expertise and experience of an Estate Surveyor and Valuers.

### **The nature of property tax**

Property tax is a compulsory revenue levied on interests in private ownership and use of landed properties and similar assets which include ground rent, tenement rate, probate tax, capital gains tax, capital transfer tax and stamp duties. This source of revenue is used by government to defray all expenditures incurred in executing any special works or services and for the execution of any work or service of particular benefit to the whole or a part of a local government area (Aliyu, 2008 ; Oyegbile, 1996).

Major heads of property tax are explained thus;

**Ground rent-** This is a form of annual rent paid to the state government by the holder of a certificate of occupancy for the occupation of land whether it is developed or not. (Section 10b of the constitution of Federal Republic of Nigeria).

**Tenement rate-** This is a form of tax levied at the local level to raise revenue for specific developmental purposes. Roads, refuse disposal, markets, slaughter houses, maintenance of primary school and maternity clinics are some of these developmental purposes. (Oyegbile, 1996). Ekong (2007), opined that this tax is aimed at promoting the total well being of inhabitants of the local community payable on annual basis on the value of each property within the local government area council.

**Probate tax-** This is levy on the total value of property which is subject of inheritance. It is also known as Inheritance tax or Estate duty.

**Capital gains tax-** This form of tax is imposed on the income or proceed accruable from transactions on land by way of sale. (LRN, 2004)

**Capital transfer tax-** This is levy on the total value of property transferred by way of gift or bequest (that is, will).

**Stamp duty-** This tax is payable ad valorem, that is, proportionate to the value of the property covered by the conveyance, lease of mortgage sought to be registered, and the payment and stamping must be completed within 30 days of execution default of which attract penalty. (LFN, 1990).

## RESEARCH METHOD AND DATA COLLECTION

Data for this study were gotten from both primary and secondary sources. The Two(2) local governments in Minna are Chanchaga and Bosso local governments. Out of the Eleven(11) and Ten(10) wards in Chanchaga and Bosso local governments, Five(5) wards from each of the local governments were randomly selected using Cluster sampling. One(1) Neighbourhood each is randomly selected from each of the selected wards. The sampling elements in each neighbourhood were selected via systematic random sampling. The breakdown is shown in Table 1.

Table 1: Showing the distribution of questionnaires administration in the study area

S/N	L.G.A	Wards	Neighbourhood	Questionnaire Administered	Questionnaire Returned	Percentage response
1	Chanchaga	Limawa A	Dutsen-kura(Hausa)	150	150	100
		Limawa B	Dutsen-Kura(Gwari)	150	150	100
		Sabongari	Sabongari	150	150	100
		Tundun-Wada South	Sauka kahuta	150	150	100
		Tundun-Wada North	Tunga(Main)	150	150	100
2	Bosso	Bosso Central I	Tayi Village	150	150	100
		Bosso Central II	Bosso low cost	120	100	83.3
		Chanchaga	Chanchaga	150	150	100
		Maikunkele	Maikunkele	150	104	69.3
		Garatu	Gidan Mangoro	50	45	90
Total			1,370	1,299	94.8	

## DATA PRESENTATION AND ANALYSIS

### Property based taxes in operation in Minna

From the above list of taxes and levies approved for collection by the state government, five(5) are property based and they are;

1. Capital gains tax
2. Stamp duties (Instrument executed by individuals)
3. Road taxes
4. Business premises registration and renewal levy
5. Right of Occupancy fees in State Capitals.

Table 2: Showing property related taxes in operation in Minna leviable by State government

Tax	Applicable	Amount collected per month	Amount collected per annum
Capital gains tax	No	-	-
Stamp duty	Yes	-	-
Road taxes	No	-	-
Business premises registration	Yes	Between N150,000 – N200,000	Between N1,800,000 – N2,400,000.
Right of Occupancy	No	-	-

Source: State Inland Revenue Office, Minna (2007)

On the other hand, the table below shows the property based taxes that are in operation in Minna. From Tables 2 and 3, two(2) property based taxes are in operation at the state level, tax on rent income(withholding tax) and Stamp duty. Withholding tax accounted for 0.07% of the internally generated revenue for the 2006 fiscal year. The possible reason is that the state government is yet to realise that property based



taxes constitute reliable and dependable source of revenue. No fund was generated from stamp duty for the said fiscal year.

Table 3: Showing Niger State Government Internally Generated Revenue

S/N	Detail of revenue	2006 approved estimate(N)	2006 actual collection(N)	2007 approved estimate(N)
1	Pay as you earn (personal income tax)	960,000,000.00	510,494,138.36	960,000,000.00
2	Direct assessment	35,000,000.00	15,180,910.40	36,000,000.00
3	Tax on dividend	10,000,000.00	6,088,438.00	10,000,000.00
4	Tax on rent income(withholding)	-	396,428.00	1,250,000.00
5	Stamp duty	1,200,000.00	-	250,000.00
6	Tax on contract	106,200,000.00	15,221,061.27	50,000,000.00
7	Tax on interest	20,000,000.00	8,788,270.67	20,000,000.00
TOTAL		1,132,400,000.00	556,169,246.70	1,077,500,000.00

Source: Niger State government approved estimate (2007)

### Property based taxes for local government

Out of the seventeen (17) property based taxes and levies approved for collection by the local government, three (3) are property based. They include the following;

1. Shops and kiosks rates
2. Tenement rates (Property rate)
3. Right of Occupancy fees (excluding state capitals)

Table 4 shows the operation of the property related taxes by the local government councils in Minna. Shops/Kiosks rates and Tenement rates as shown in the Table 4 above are in operation in the local governments at the study area.

Table 4: Showing property related taxes levied by local government councils

S/N	Local government	Shops and Kiosks rates	Tenement rates	Right of occupancy
1	Chanchaga	Yes	Yes	Known but not in force
2	Bosso	Yes	Yes	Known but not in force

### People's attitude to payment of property tax

Table 5: Showing the occupational distribution of respondents in Minna

S/N	Neighbourhood	Civil servants	Professionals	Self employed	Antisans
CHANCHAGA					
1	Dutsen Kura(Hausa)	83	20	41	6
2	Dutsen Kura(Gwari)	15	5	100	30
3	Sabongari	10	9	106	25
4	Sauka-Kahuta	45	10	82	13
5	Tunga	30	30	90	-
BOSSO					
1	Tayi Village	71	15	55	9
2	Bosso low cost	58	7	17	18
3	Chanchaga	73	14	50	13
4	Maikunkele	45	4	40	15
5	Gidan-Mangoro	2	-	30	13
Sub total		432	114	611	142
Total					1,299

The occupational distribution of respondents in Sampled Neighbourhoods is being represented in Table 5. The self employed and the civil servants proved to be the

major occupation of the respondents in the sampled neighbourhoods represented by 47.0% and 33.2% of the total respondents of 1,299.

### Various form of taxes paid by the respondents

In this section, various form of taxes paid in Minna is discussed.

Table 6: Showing the various form of taxes paid by the respondents

Form of Tax	D/Kura Hausa	D/Kura Gwari	S/gari	S/K	Tunga	Tayi Villa	Bosso low cost	Chanchaga	Maikunkele	Gidan Mangoro	Total
Personal income tax	110	55	75	90	89	115	68	84	73	7	766
Value Added Tax	28	10	17	13	5	10	10	14	12	3	147
Company Tax	3	4	11	7	10	7	-	-	-	-	42
Development Tax	6	6	5	2	4	3	9	6	-	-	41
Property related taxes(Tenement rate, Kiosk rates)	15	20	9	10	13	16	8	2	8	-	101
Total											1,072

From Tables 5 and 6, 90.5% of the respondents pay tax generally, out of which 71.5% is personal income tax while property related taxes stood at 9.4%. This result shows that there is negative attitude toward the payment of property related taxes in Minna.

### Proportion of tax payment by respondents

The respondents distribution of level of acceptance of payment of tax in the Sampled Neighbourhoods is being represented in Table 6, while Table 7 represent the various form of taxes paid by respondents.

Table 7: Showing level of tax payment

Category of Respondents	Dutsen kura, Hausa	Dutsen Kura, Gwari	Sabong ari	Sauka-kahuta	Tunga	Tayi Villa ge	Bosso low cost	Chanch aga	Maikunk ele	Gida n-Man goro	Total	%
Those that pay tax	140	140	141	140	134	140	91	137	93	20	1,176	90.5
Those that do not pay	10	10	9	10	16	10	9	13	11	25	123	9.5
TOTAL											1,299	

From table 8, it is evident that majority of the respondents representing 90.5% pay tax, meaning that tax authority in Minna is doing much in ensuring tax payment. This could also attest to the tax collection strategy as been effective. The minority representing 9.5% who do not pay taxes are tax evaders. Though, it is appreciated that majority pay tax, the question of willingness to pay is another issue. This is addressed in the next section.

### Willingness of respondents to pay tax

Tax is a compulsory levy paid to a constituted authority by private or corporate persons for the support and promotion of specific socio-economic objectives. Despite the importance of tax, are people willing to pay? Or they pay because they must pay without any motivation? Table 9 gives the responses as to whether or not people are willing to the pay tax. Sampling people's willingness to pay tax, this research from Table 9 reveals that 41.6% of the respondents are willing to pay while 52.6% are not

willing to pay. The major reason advanced why people are not willing to pay tax is that there is no feasible gain from the taxes collected by the government. Reasonable percentage of the neighbourhood sampled still experience erratic power supply, inadequate or no water supply as well as bads road networks.

**Table 8: Showing willingness or otherwise of respondents to payment of tax**

Category of Respondents	Dutsen kura, Hausa	Dutsen Kura, Gwari	S/Gari	S/kahuta	Tunga	Tayivillage	Bosso Low cost	C/C haggala	Mai kuk ele	G/M angoro	Total	%
Will always be willing to pay tax	85	60	100	17	45	50	30	88	60	5	540	41.57
Will not be willing to pay tax if allowed	65	70	35	122	95	100	70	42	44	40	683	52.57
Indifferent											76	5.85
TOTAL											1,299	

### **Factors responsible for the attitude of people toward payment of property based taxes in minna**

This research identifies the following as the factors responsible for the negative attitude of people toward payment of property based taxes in Minna:

1. **IGNORANCE:** Most of the people still lack sufficient information on what property tax is all about, why they have to pay the tax and the parameters for arriving at the amount of tax payable. Also, the introduction of taxes indiscriminately put the people in great confusion of double or multiple taxes.
2. **LACK OF AWARENESS:** The reseach revealed that public enlightenment is fairly done. Most people complaint that issues relating to property taxation are not always spread on the pages of Newspapers, particularly the states own newspaper.
3. **CORRUPT GOVERNMENT OFFICIALS:** The study also show that government officials paraded tax payers places of business claiming to be generating money for government without demand notices in respect of taxes or levies being demanded. Some of the tax payers claimed that government officials lack records and as such they could not easily trace defaulting tax payers. They mentioned that these government officials repeatedly ask for a particular form of tax even when it has been paid for. Some aggrieved tax payers also noted that some government officials put in sentiments most expecially when a tax payer could speak the native language and or if such a person is an indigen.
4. **FAILURE TO USE TAX PROCEEDS FOR VISIBLE PROJECTS:** People find it difficult to believe that the dividends of democracy are at their door steps. Majority of the tax payers said that this is reflected in the inadequate infrastructural facilities that characterised most of the neighbourhoods in majority of the wards in Minna. Others include;  
 Lack of political will on the part of government  
 Poverty rate of tax payers  
 Lack of fund/logistics on the part of government agencies saddled with the responsibilities of tax administration.

## **STRATEGIES FOR POSITIVE ATTITUDE OF PEOPLE TOWARD PAYMENT OF PROPERTY BASED TAXES IN MINNA**

The possible solutions to the various problems on attitude of people toward property tax payment in Minna include amongst others:-

- i. Vigorous awareness campaign.
- ii. Comprehensive enabling edict.
- iii. Sensible and wise use of funds, collection of rates, levies and taxes should be juxtaposed with provision of amenities and infrastructures.
- iv. Placing checks on multiplicity of rates, levies and taxes.
- v. Resourcefulness on the part of government officials
- vi. Engaging the use of Estate Surveyors and Valuers in Rating departments at the local government councils and State Inland Revenue Service respectively.

## **CONCLUSION**

This research has examined people's attitude toward tax payment in Minna, Nigeria. Almost half of the respondents are not willing to pay tax. With strong commitments on the part of relevant government in providing infrastructures, there will be appreciable level of willingness on the part of the tax payers.

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# PRE-CONSTRUCTION INFORMATION IMPLEMENTATION IN GHANA USING UK'S CDM 2007 MODEL

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The construction industry has been seen as one of the hazardous industries. This is because construction industry has a poor health and safety performance record compared to other industries all over the world. However, there has been increased awareness for improving construction site safety while developing safety programs and increasing safety inspection (Jaselskis et al., 1996). This paper therefore represents the results of construction professional/government agencies on the implementation of pre-construction information plan in some selected regions of Ghana. The aim of the research is to find out whether the implementation of pre-construction information similar to UK's CDM 2007 model would improve upon health and safety performance in the construction industry in Ghana. The first objective of the research is to investigate into the history of health and safety in UK and carry out detail research in CDM 2007, with particular reference to pre-construction information. The second objective is to investigate into health and safety in Ghana. Within this context, a detailed questionnaire was developed and administered. Data collected were analysed using SPSS. The results of the survey show that the implementation of pre-construction information will improve upon health and safety performance in Ghana. Also, the research reveals that the pre-construction information, if implemented, will help reduce accidents, cut down on contract delays, reduce bureaucracy, manage and control cost and reduce(or eliminate) contract claims/disputes. The research further established that, in Ghana, the pre-construction information should be prepared by project managers.

Keywords: pre-construction, CDM 2007, health and safety, performance.

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# **PROBLEM OF READY-MIX CONCRETE PRODUCTION IN THE CONSTRUCTION INDUSTRY IN NIGERIA AND ITS COST IMPLICATION**

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The use of defective construction materials has been identified as one of the major cause of the perennial problem of structural failures in the construction industry in Nigeria leading to huge loss of lives and properties. This paper discusses the problem of ready-mix concrete production and use. Also the implications of such problem on cost were examined. This is aimed at identifying the major problems affecting ready-mix concrete production and remedies to such problems. The paper was based on literature review and intellectual discussion on the issue, with expert. The paper noted that the problems facing ready mix concrete production are many. Some of them genuine national standard used for quality multinational construction companies, not much progress has been recorded by the indigenous companies, who for most part of their concrete production, are still near primitive level. Also problems concrete production leads to delay which brings about variation and hence cost overrun. Parts of the recommendation made are government, professional bodies and Nigerian building and road research. Institutes have a role to play, by introducing measure to guide remedy those problems such as strict enforcement of national building code, use of material that would serve as a partial replacement of cement.

Keywords: ready mix concrete, cement problem, quality control, sustainability.

## **INTRODUCTION**

Concrete is the most widely used construction material all – over the world (Dahiru and Zubairu, 2008). It is obtained by mixing cement, water and aggregates (and sometimes admixtures). According to Mehta and Monetrio, (2006) it is estimated that the present consumption of concrete in the world is of the order of 11 billion metric tonnes every year. Man consumes no material except water in such tremendous quantities. This is because of its low-cost, high strength, durability, versatility and low maintenance in comparison with other construction materials like steel. Okekere (2007) also stated that concreting constitutes between 50% - 70% of the total cost of materials used for a building. The quality of concrete in any building therefore, determines to a large extent, the quality of building production in terms of the performance of such structure, production cost and delivery time.

However, concrete production entails processes in which quality control are difficult to ensure, as there are too many variables in environmental condition and workmanship that affect the quality of concrete. Neville and Brooks, (2002), Gupta and Gupta (2008) and Shetty (2009) observed that the properties of concrete is a function of quality and quantity of materials used and the way they are mixed, handled, compacted, finished and cured. It also depends on time and ambient humidity. There is always the possibility that even a well designed mix may still

produce poor quality concrete due to incorrect procedure used in the production and subsequent placing, compacting and curing processes.

The constituents for a good and bad concrete may be exactly the same, it is only the knowledge and skill of the producer often without additional cost of labour that is responsible for the difference. Unfortunately, according to Neville (2002) the engineer often knows less about the concrete of which the structure is made than about other popular manufactured construction materials, like steel. This is particularly true in the case of developing countries like Nigeria. This means there is the need to take measures throughout the entire stages of production of concrete so as to ensure the production of qualitative concrete. For, quality of materials has influence on the performance of a structure and this in turn affects the stability of such a structure. According to Taylor (2005) there is an interrelationship between material behaviour, material failure and building failure.

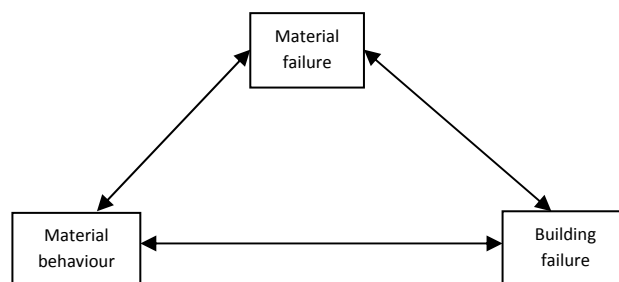


Figure 1: Interrelationships between the concepts of failure and behaviour

Source: Taylor (2005 p 3)

According to Ovajimoh *et al* (2001) use of defective construction materials was identified as one of the major factors responsible for the problem of structural failures in the building construction industry in Nigeria. Since concrete is not only the most popular but also, the most widely used construction material, this means substantial part of many structures are made of concrete added to the fact that it is a heterogeneous material consisting of various constituents of varying qualities. This means any problem relating to concrete is an important problem that should be given the attention it deserves. Also, analysis of issues relating to structural failures in the building industry in Nigeria and indeed West Africa would be incomplete without reference to the problem of concrete.

This paper discusses the problem of ready – mix concrete and its application in the construction industry in Nigeria. Besides that, the implication and consequences of such problems on the overall - cost of the project, hence the success of project were examined. This is aimed at bringing to the fore, problems relating to the production and use of concrete in the construction industry in Nigeria. Besides that, measures to be taken in order to improve on the quality of the concrete, reduce time and cost overruns, and hence ensure the success of the project without compromising the ability of future generation to achieve their needs, so that a sustainable built environment is achieved.



## METHOD OF STUDY

Secondary information was used in writing this paper through wide literature review of three different sets of information on the subject: Firstly Published and unpublished textual materials which include books, journals, theses, lecture notes and periodical. Secondly, Information retrieved from internet and thirdly, Intellectual discussions with professionals and learned scholars in the field of construction.

Since material failures are the result of the way they were manufactured, selected or incorporated into the building. If they fail, they must have been produced or used, inappropriately for the intended purpose. This means materials failure represent shortcomings somewhere in the design or construction.(Taylor,2005). In order to discuss the problem of concrete production in the construction industry in Nigeria, the following issues, as they relate to concrete production, were examined: Production process, quality control measures used, quality of the concrete in the construction industry, professionals that design and those that are involved in the production and supervision, the condition in which concrete is produced in Nigeria –whether there are measures put in place to ensure quality, like standards/code of practice guiding such production and the extent to which standard/code or legislations are enforced and the level of technology used in concreting. Also sustainability in relation to concrete production was discussed,

Besides that, how the problems of concrete production affects time and hence, cost were examined Conclusion was drawn and recommendations made.

## CONCRETE PRODUCTION IN THE NIGREIAN CONSTRUCTION INDUSTRY

### Level of concrete production

According to Okekere (2007), concreting can be classified into two types – primitive and modern. In the primitive level, all the processes in concreting: mixing, transporting and placing are carried out using manual labour. Characteristically, this is the level of concreting attained by most small and medium sized indigenous construction firms. With that, batching is by ‘eye’ depending on the experience of the mason. . This is the level of concreting attained by most small and medium sized indigenous construction firms. Garba *et al* (2004) observed that due to low level of education the supervisors involved in concreting do not understand what concrete mix design stands for.

In the case of modern method of concrete production, it involves the use of scientific and technological devices in carrying out almost all the various processes involved right from the mix design, to the placement of the concrete. This, according to Okekere (2007), is the method adopted by most of the large multinational construction firms such as Julius Berger, Sterling, G. Capper, RCC, e.t.c. These construction firms are responsible for most of the complex constructions such as high rise buildings, National stadium, Theaters, monumental edifices, etc., Okekere (2007) further noted that although the standard of concreting by these firms compares with those of the developed countries, their activities have not resulted in the indigenous growth of techno-material bases for the industrialization of construction in Nigeria. Thus, if for any reasons, those firms leave Nigeria; there is no much progress made as regards to the level of construction.

### **Quality of concrete produced in Nigeria**

From the foregoing it can be seen that the bulk of construction activities in Nigeria is handled by foreign firms and due to what Okekere (2007) called “individualistic character and technology” adopted by these firms added to the fact that there is little or no regulatory control over their activities. As such, it is difficult to characterize concreting in Nigeria. For example, most of the expatriate firms import cement for their use without any verification of the quantities and qualities of such cements.

According to Earth watch (2005) the Standard Organization of Nigeria (SON) cannot effectively control the standard of concreting in Nigeria because of the following reasons: Firstly, most of the major construction works are executed by the multinational construction firms using expatriate staff and their national standard. Secondly, SON relies on foreign standards for certification of imported materials due to absence of true national code. Because in few instances where there are standards, like the NIS, they are mere carbon copies of foreign standards. Thirdly, there is lack of qualified staffs that would be able to discharge such responsibility. Besides that, the Nigeria Building and Road Research Institute (NBRI) and the professional bodies have not been living up to expectation in term of initiating research into local construction materials and establishment of genuine national standards for construction materials. It is because of the above mentioned problems that the quality of concrete produced across the country varies greatly with a coefficient of variation as high as 27% (NBRI, cited in Okekere, 2007).

## **PROBLEMS OF CONCRETE PRODUCTION IN NIGERIA**

### **Factors affecting concrete production**

Many experts have made observations on the problems associated with concrete production in Nigeria. For instance Ovajimoh *et al* (2001) were of the view that most construction works are carried out by unqualified workers. What makes it even worse, is absence of code that would regulate the quality of concrete used in the construction industry in Nigeria. It was only recently (2006) that National Building Code was approved and up to now it is not being enforced (Muawiyya, 2009). Besides that, in view of the roles played by tests most especially in ensuring strict adherence to the minimum standard as provided in the conditions of contract, giving confidence to the supervisor and when there is dispute, it serves as a means of resolving such disputes. In most contract works large amount of money is budgeted for these control tests. However some contractors view it as an avenue to cut corners as such, the tests are either partially carried out or not done completely. For example the compressive strength test of concrete is supposed to be carried out for 1, 3, 7, 14, 21, and 28 days to enable the strength to be monitored. However, in most cases, it is only the 28 days that is carried out in order to save cost. According to Ovajimoh *et al* (2001) some do not see the need for the tests until structural failure or the work is condemned by the supervising agent.

But Okekere (2007) is of the view that the problems associated with concreting in Nigeria can be grouped into four main categories, namely:

- (i) Economic
- (ii) Technical
- (iii). Low-level of training of supervisors involved in concreting
- (iv) Climate.

These factors separately and collectively affect the trends in concrete production in Nigeria in terms of increasing technological development in concreting, industrialization of concrete production, increasing productivity of labour, an all-year-round concreting and reduction in the consumption and wastage of materials. These, collectively determine to a large extent, the quality and volume of concrete work.

**i. Economic problem in concreting**

Technological development leads to, replacement of manual labour with effective machines and equipment so as to make the various production processes less cumbersome and more cost effective. In the field of concrete production, this will mean the substitution of the primitive way of producing concrete with the good techno-material bases that will ensure the industrialization of the production processes which support factory and mass production of pre-cast concrete components or the mechanization of the processes in-situ concreting.

**ii. Technical problem in concreting**

Another major problem militating against the effective production of concrete in Nigeria is technical problem. This is considered the most significant problem. It cuts across the non-existence of relevant national standards for quality control of all concrete materials, lack of qualified technical manpower that are well trained in building production. According to the communiqué issued at the end of the 17<sup>th</sup> National Conference on material testing and quality control, the shortage of trained manpower was regarded as the major problem in quality concreting.

**iii. Low-level of training of supervisors involved in concreting in Nigeria**

Another problem is the low-level of training of the supervisors that are involved in the production of concrete. According to Garba *et al* (2004) the percentage of people with low-level of training (49%) is quite substantial and a cause for alarm. The problem with low – level of education was evidently displayed when the supervisors could not explain how they proportion their concrete. Results of investigating by Garba *et al* (2004) also show that 71% respondents used prescribed mix. Only 3% conduct the basic tests on aggregate before they are used. While 75% use the volume batching method.

Investigations also reveal that 51% of the respondents do not scientifically assess the strength of the hardened concrete (Garba *et al*, 2004).

**iv. Climate problems in concrete production**

The first insight into the problem of concreting in Nigeria was the publication by Ridley in 1957 and 1985 during the construction of Iddo bridge in Lagos. According to these publications, concrete prepared in Lagos showed 15% reduction in the 28day cube strength in comparison with the strength of the same concrete mix prepared in London with temperate climate condition. It was also stated that the relative strength of concrete in Lagos was over 80% at the 7<sup>th</sup> day in comparison with less than 25% recorded in Europe (Okekere, 2007).

According to Hughes and Taylor (1962) concrete prepared in Accra, Ghana which has similar climatic conditions as Lagos, Nigeria, showed cube strength at every age considerably higher than in Europe with a relative cube strength of 75% achieved on the 7<sup>th</sup> day after casting.

The contradiction in these publications is as a result of the problems associated with high relative humidity as is characteristic of the Nigerian tropical climate (Okekere, 1991). This has led some experts in hot weather concreting in concluding that the study of the effect of climatic condition on the properties of concrete and on concreting as far from being conclusive (Okekere, 1987).

This situation led Okekere (1991) to carry out an in-depth research of the prevailing local climatic conditions in various parts of the country with the view to analyzing their respective characteristics and effects on concreting.

In this study, Nigeria was divided into four climatic zones for purposes of concreting, namely:

- (i) *Zone I* - *Hot Dry*
- (ii) *Zone II* - *Temperate Dry*
- (iii). *Zone IV* - *Hot Humid* and
- (iv). *Zone IV* - *Warm Humid*

These 4 climatic zones are characterized with very high average daily, temperatures ( $25^{\circ}\text{C} \leq t_d \leq 35^{\circ}\text{C}$ ) and high relative humidity of between  $60^{\circ} - 90^{\circ}\text{C}$  nearly all-year-round. While in some zones (notably III and IV) there is the problem of prolonged torrential rains for 3 – 4 months in a year (Okekere, 2007).

### **Climatic problems in concrete works**

Okekere (1991) observed that the problems related to climatic conditions in concrete works in Nigeria could be classified into the following categories.

#### **(i) Problems due to high temperature and high relative humidity**

Despite the volume of published research findings on the problems of concreting in high temperature, there still exist contradictions as to the effect of high temperatures on the properties of concrete. One of the reasons for these apparent contradictions is the inability of researchers to simulate exactly the temperature and humidity conditions in the laboratory where experiments are usually carried out. As a result, different values are usually obtained for test parameters depending on the different laboratory conditions. Where experiments are carried out in the open, the climatic conditions vary from zone to zone and from season to season and therefore have varying effects on the concrete.

On the whole, research findings show that concrete cast in different climatic zones in the tropics with different climatic conditions have varying strengths at the same age. This phenomenon has been interpreted to be due to, the incomplete hydration process occasioned by the early loss of some of the mixing water in the concrete, resulting in the premature hardening of the concrete due to drying out, etc.

#### **(ii) Problems during the harmatan**

This category of problem is particular to the climatic zones I and II during the harmatan period. It is usually characterized with low relative humidity coupled with dry and dusty wind. Results of the research by (Okekere, 1991) have shown that such climatic conditions have the following adverse effects on the concrete.

Firstly, the fresh concrete loses its workability very fast. Secondly, harden faster than under normal conditions because of the drying effect of the harmatan wind on the fresh concrete. This could be due to the fact that the hydration process of the cement is

prematurely eliminated thus leading to early stopping of the strength development of the concrete with age as it is usually the case under normal conditions. This results in the decrease of the day cube strength of the concrete when compared with that under normal weather conditions.

Result from researches carried out the Negev deserts in Israel on the combined effects of high temperature and relative humidity on concrete (Minorov, 1960 in Okekere, 2007 ) show that the degree of reduction in terminal strength of the concrete depends on the rate at which the concrete loses its mixing water which on its parts is a function of the wind speed, the temperature and relative humidity gradient between the concrete and the surrounding air (Klierger, 1959 in Okekere, 2007).

## **(ii) Problems during rainy season**

These categories of problems due to climatic conditions are seasonal during the wet seasons in all climatic zones. They are however more pronounced in the III and IV zones. Among the problems encountered when concreting during the rainy season are:

Unexpected interruption of concrete works which sometimes result in the disruption of the project schedule and in most cases result to the formation of construction joints at unsuitable positions in the elements being concreted; The risk of materials (cement, sand, gravel, etc) being mixed with water; destruction of site offices by torrential rains and storm. In the coastal areas (zone IV), due to prolonged rainfall during the rainy season, concrete works may be suspended for some days resulting in the disruption of the project schedule and the construction rhythm and at times may lead to a delay in the project completion time. This invariably affects the effective utilization of plant time and the work force which may result in increase in contract sum.

## **SUSTAINABILITY ISSUES**

Discussion on the problem of concrete production in the Nigerian construction industry will not be complete without reference to sustainability issues. According to Taylor,(2005) there can be few aspects of construction which, in recent years have attracted greater attention than sustainability. This is due to the fact that there is the reciprocal impact between human actions and the biophysical world. This is particularly true in the case of construction activities. That explains the reason why construction industry is referred to as the forty percent industry because it consumes approximately 40% natural resources and emits nearly 40% waste (Agenda 21 in Dahiru, 2005).

Taylor (2005) observed that the question is increasingly being asked as to whether current rates of exploitation of the planet's resources can be sustained without serious implications for the future?

Aggregate is one of the important ingredients used in the production of concrete. According to Neville (2002), 70 – 80% of volume of concrete is occupied by aggregate; the volume of aggregate can be up to 90% for a bituminous concrete. However, the extractions from the earth and processing for use (Quarrying) have considerable environmental, economic and social impacts on the society. According to Mbamali (2005), the quarrying practice in Nigeria is unplanned and unregulated; it is, therefore unsustainable and hence unsatisfactory. Similar observation was made by Oborien (2005). Besides that, Shetty (2009) noted in future natural sand will not be available in large quantity for heavy constructions.

Another serious problem associated with concrete production is the use of cement. As an important constituent of concrete, cement is scarce and expensive. According to Coutinho (2003) the current cement production rate of the world is approximately 1.2 billion tonnes/year this is expected to grow to about 3.5 billion tonnes/year by 2015. In Nigeria, despite the fact that there are about 8 modern cement factories there is a shortfall of well over 3 million tonnes of cement between demand and supply (Abubakar, 2009). The country largely relies on importation of this very important constituent of concrete. During my discussion with one of the experts, he observed that Dangote cement, which is the commonest brand, is imported in bulk and bagged in Lagos - Nigeria. Lawal (1999) in Abubakar (2009) noted that the cost of cement has been rising sharply in Nigeria owing mainly to the drastic changes in the value of the country's currency especially when compared to foreign currencies and the increasing pump price of petroleum within the country. This tends to affect concrete production in many ways. Firstly, it leads to increase in the cost of concrete and hence construction materials in Nigeria. Secondly, it leads to what Ovajimoh *et al.*, (2001) called "Cutting Corners" by the contractor on the right Quality and Quantity of cement to be used. Production of cement leads to some environmental problems. Cement is manufactured through the extraction and processing of mineral resources such as limestone. This affects the visual landscape. Also, during its production, it leads to the emission of CO<sub>2</sub>. According to Bremner (2001) with every ton of cement produced, almost a ton of CO<sub>2</sub> is emitted. About 0.5 tonnes comes from decomposition of the limestone and the balance is generated by the power plant supplying the electricity to turn the kiln and ball mills to grind the cement plus the fuel burned to fire the kiln. Other generation such as operating ready mix trucks adds to the CO<sub>2</sub>. Also, as regards to conventional concrete mixes, about 480kg of CO<sub>2</sub> is emitted per cubic metre of concrete or 20kg of CO<sub>2</sub> per 100kg of concrete produced. This, according to Bremner (2001) amounts to approximately 7% of the total CO<sub>2</sub> generated worldwide.

Cement production even in the developed countries like, US, UK, Canada etc leads to other problems such as particulate emissions. From the exhaust gas ranging from 0.3 to 1.0kg/tonne, visual pollution arising from Quarries used to gain raw materials for cement production or for obtaining sand and gravel, noise pollution during production. There are also adverse health effects. Ozone (which is formed when nitrogen oxide and volatile organic compound mix in sunlight) cause health such as asthma attack, sore throat, coughing. Also, increased chromium content of cement has side effects. According to Walton (1990) in Dahiru (2005), cement powder causes disease called dermatitis when it is inhaled and frequent contact with it leads to skin disease.

Furthermore, water, which is also a key sustainability concern, is needed for the production of concrete and it is supposed to be portable tap water fit for drinking. However, water is also scarce up to now there is not enough water in most of the cities in Nigeria, not to talk of the rural areas. This explains the reason why the result of an investigation carried out by Babanmaryam (2001) revealed that lack of water supply is responsible for interrupted curing of concrete and that in many instances contractors use water that is not pure in both the production and curing of concrete. This, will ultimately affect the quality of concrete and in large contracts, where such issue may not be compromised, the cost is most likely going to be high due to the extra effort that construction firms must put to get the water of such quality.

## DISCUSSION

### Implication of problem of concrete production on cost

From the foregoing discussions, it would be noted that experts have identified many of the problems faced by the construction industry in Nigeria, as regards to concrete production. However, there are some important issues which seem to be ignored. Prominent among them is the method of production. This is a factor that leads to serious problem of concrete production. According to Wakili (2007) over 90 % of building construction work use the conventional/traditional system; which uses in-situ net construction of concrete components and sandcrete blocks for the walling units. In-situ concrete production has many problems associated with it. For, it is labour intensive and many of the labour force that produces concrete, in the Nigerian construction industry are unskilled (Garba *et al*, 2004). This leads to other problems such as poor quality concrete, generation of waste and delays in the execution of work. Besides that, in areas that experience high rainfall, it may be very difficult to carry out work during the rainy season. However, this is not the case with precast concrete where the whole production process is shifted from the construction site to yard where it is carried out under controlled condition.

As it was observed earlier, in-situ concrete production is one of the major factors that cause delays these results in time overrun and consequently, leads to cost overrun. Studies by Giwa (1988) established that initial and final contract sums for construction projects increased by about 113%. While Elinwa and Buba (1993) observed that project overrun their initial contract sum by between 8 to 133%. There are many factors that are responsible for this problem. One of the major problems is variation (Giwa, 1988, Nnorom, 1998, and Chindo, 2006). According to Giwa (1988) delays leads variation and fluctuation; and these ultimately lead to cost overrun. Problem of delays due to in – situ concrete production is not confined to parts of Nigeria where there is high rainfall, even in areas that experience extreme heat or hamattan. Also, Kaming *et al* (1998) stated that in Nigeria shortage of certain materials was identified by construction workers as their main problem, and was traced to incessant cash-flow experienced by contractors, resulting in suppliers not being paid for materials previously delivered and consequent disruption of later deliveries. Also, lack of materials not only causes delays, but a consequent decrease in productivity and resulting to cost overruns. (kaming, *et al*, 1998). In a recent study undertaken by Yashim (2010) an analysis of the elemental costs difference (between estimated and actual cost) contribution to the overall project cost was carried out. It was observed that the highest percentage (24.32%) of respondents identified fluctuations in materials and labour prizes as factors which have more influence on cost overruns. Since over 80% of construction materials are imported and the value of currency, is unstable, it is obvious that will affect the progress of construction work and cost of such work (Wakili, 2007).

### Remedy

Another important issue which was relegated to the background is the measures that should be put in place in order to solve the problem. Most of the problems discussed can be solved by the government, professional bodies and NBRI. While it is true that there are legislations regulating the practice of all professions in the built environment, most of these legislations are not enforced by the government. There are two major ways that government can remedy the problem of concreting in Nigeria. First, strict enforcement of legislation. Second, leading by example, this means all

government projects must be handled by qualified professionals. Government should find ways of encouraging the indigenous construction firms putting a limit on the number of public projects that a multinational construction firm can handle.

Furthermore, government should borrow a leaf from by taking measures to reduce the side effects of production of cement. For instance, Environmental Protection Agency should prepare a guideline for emission limit for hazardous and non-hazardous waste; introduce a fund, similar to the Education Tax Fund, in which each industry will pay certain amount of money. The money can be used to take measures that will mitigate the side effects of construction activities, such as tree-planting, sculpture the topography of sites that were damaged by quarries and mining and enforcement of safety regulations on construction sites.

NBRI and professional bodies have a role to play. There is the need for them to carry out research on local construction materials, most especially on material that can serve as full or partial replacement of cement, sand or aggregate. They should assist in preparing true indigenous standards for construction materials. In recent years a lot of progress has been recorded as regards to the use other materials as partial replacements of the various constituents of concrete. For example: blast furnace slag and various other solid wastes from metals refining can be used as aggregate for concrete, Fly ash from coal fired electric generating plants can be pelletized and then fired in a travelling grate to produce a low density aggregate, In addition, fly ash can be used as a pozzolan to partially replace cement. When slag, fly ash and silica fume are used as pozzolan, the CO<sub>2</sub> emission associated with the production of concrete can be reduced by a half or more. Success has also been reported in the use of byproducts of the metallurgical industry to produce cement less concrete (Bremner, 2001). According to Dahiru (2007) carbide waste can serve as a partial replacement of cement in concrete production. A study by Dahiru and Zubairu (2008) revealed that risk husk ash can also be used as a partial substitute of cement.

Low density aggregates made from expanding shale, clay, slate or blast furnace slag can be used to produce light weight concrete. Recycling of concrete demolition waste is common in Japan and Europe. Gambo (2000) also reported that lateritic aggregate can be effectively used as aggregate for the production of concrete. In short there are many materials that can be used in the production of concrete. There is need for further research and enlightenment campaign.

## **CONCLUSION AND RECOMMENDATIONS**

### **Conclusions**

Based on the foregoing discussion, the following conclusions were drawn:

Concrete production in the Nigerian construction industry is faced with many problems ranging from lack of measures in form of legislations, standards/codes of practice and strict enforcement of the provisions of standard. Incompetent/manpower, faulty Quality control measures used, problem of the weather condition, etc.

There are also environmental problems associated with the extraction of the mineral resources and the use of such raw materials for the production of ingredients used for the production of concrete.

Problems of concrete production affects the quality and results to delays which in turn affect the duration of the project thus leading to Cost overrun

Inadequate measures put in place to take care of environmental problems and hazards.



Despite the many problems facing concrete production, it remains the most important construction material used in Nigeria.

### Recommendations

There should be speedy adoption and strict enforcement of the National Building Code (2006).

All the professionals in the Building Industry should unite to ensure strict enforcement of the Building Code and should assist the SON in preparing material standard that would be used to control quality of construction materials.

Countries in the West African Sub – Region should borrow a leaf from other regional groupings such as the European Union (EU) in coming together and come-up with a unified code similar to Euro-Code.

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# RESIDENT'S PERCEPTION OF THE CENTRAL SEWAGE SYSTEM IN THE FEDERAL CAPITAL CITY, ABUJA-NIGERIA

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Urbanization and increase in population influence the rate of waste generation and the need for sufficient housing and infrastructure. The Federal Capital City (FCC) which is among the fastest growing cities in Africa, is faced with several challenges such as wastewater disposal, solid waste disposal, housing provision, transportation, power supply amongst others. The FCC has a fairly developed central sewage system which is rare for most Nigerian cities. The use of sewers is not without its challenges and given a poor reputation for maintenance in developing countries, these challenges could be overwhelming. This study investigated the perception of the residents of the performance of the central sewage system in the FCC. The study was carried out by administering a questionnaire to residents in Five (5) districts of the FCC. The responses were analysed using simple statistical tools such as Means, Percentages and Standard deviations. From the analysis, it was observed that the common problems identified were sanitary sewer overflows (SSO), odours from broken sewer lines and manholes and incomplete sewer lines. The respondents also claimed that maintenance efforts on the sewer were not satisfactory. The study concluded that the operation of the central sewer system is not without several challenges stemming from inadequate maintenance practices. As a result, the observed faults are not properly addressed. The study recommends that the operators of the sewer system adopt maintenance techniques to tackle the problems observed and implement an appropriate feedback system for performance monitoring.

Keywords: central sewage system, Federal Capital City, Nigeria, performance.

## INTRODUCTION

Developing countries are plagued with enormous infrastructural problems which include insufficient road networks, housing, rail transportation, water supply and municipal sewer systems. Sewage refers to domestic, municipal or industrial liquid waste products conveyed by a sewer. It consists of water borne from human, domestic, animal or trade wastes and other materials. Sewers are underground pipes that convey wastewater to a pollution control plant where it is treated and then released to water bodies (Karvonen, 2004).

There have been several improvements on the methods of collecting, conveyance and disposal of wastewater and municipal sewage since the early century. Despite these improvements, the challenges of increased environmental pollution and population density seek better methods for disposal such as the municipal sanitary sewer system (VanCalcar, 2006). Maintenance of infrastructure has been identified as a serious challenge confronting most developing countries.

Karvonen (2004) stated that sewer systems had initially been viewed as a luxury but later deemed a necessity as the demand for water use and disposal in urban areas

increased. In 1976, the Federal Government of Nigeria took the decision to move the seat of Government from the overcrowded and overpopulated city of Lagos to a brand new city at the heart of the country. The Federal Capital Territory was designed to incorporate modern infrastructure to address some of the other problems observed in other Nigerian cities especially the former capital, Lagos.

In view of the above, this study seeks to investigate the perception of residents of the Federal Capital City on the performance of a very key component of the built environment, the Central Sewer system with a view to identifying possible problems and proffer ways for efficient service delivery.

## THE CENTRAL SEWAGE SYSTEM IN THE FCC

The Sewage System designed and installed for the Federal Capital City, Abuja is a centralised sanitary sewer collection and conveyance system which forms an extensive, valuable and complex part of the city's infrastructure. It is provided to improve sewage disposal and thereby contributes to the objectives of maintaining public health for its populace. It is a gravity collection system, with no lift stations, force mains or other powered devices. This type of system presents a number of advantages: the operational and maintenance costs are much lower than for pumped systems; the probability of a catastrophic type of system failure is extremely low; staging of construction (including expansion) is simplified; and energy requirements are nil.

The system is also a separate wastewater collection system, i.e. storm runoff is not allowed to enter the sanitary sewerage system. The system is capable of staged construction to match the growth of the city and the option of future re-use of the treated wastewater by isolating industrial and domestic sanitary sewer system wastewater outputs. The major components of the Central Sewage System are;

- a. **The Interceptor Sewers:** The interceptor sewer system are a network of conduit, reinforced, pre-cast and ductile iron pipes which collect raw sewage from districts and conveys them to the Sewage Treatment Plant. The interceptor sewer system are grouped and grouped and named for convenience of design and construction as schedules I, II and III.
- b. **The Main Sewage Treatment Plant:** The Sewage Treatment Plant constructed for Abuja is located in Wupa and is designed to handle a population of 700,000. It is a fully mechanized and computerized plant that handles the treatment of an endless flow of waste water through aerobic breakdown of micro-organisms found in waste water before discharging the treated effluent into the surrounding river basins. The major components of the main sewage plant include the influent pump station, screening plant, grit removal chamber, aeration tanks, final clarification tanks, sludge treatment and other support infrastructure (IPA 1979).
- c. **Other components include:** Manholes, Precast concrete rings or reinforced concrete risers and cones; Manhole Cover - Precast concrete or steel iron; Pipes - Ductile iron, PVC and precast concrete pipes

The Federal Capital Development Authority (FCDA) built and owns the Central Sewage System in the Federal Capital City on behalf of the Federal Government. It operates and maintains the system through the Department of Engineering Services, FCDA and Abuja Environmental Protection Board (AEPB). The potential health and environmental risks that may be associated with the improper operation of the sewage

system justify the need to optimize the performance, operation and maintenance of the sewage collection and conveyance system in the Federal Capital City Abuja.

## RESEARCH METHODS

The study was conducted in Phase I of the Federal Capital Territory consisting of the following five (5) districts: Maitama, Asokoro, Wuse I and II, Garki I and II and the Central Area. A random sampling technique was used to select 20 residents connected to the sewers lines in all of the five districts, making a total of a hundred questionnaires. The area of interest was to identify the commonly occurring problems observed by the respondents. Data obtained from the questionnaires were analysed to compute the means, percentages, standard deviations of the distributions and are presented in tables and figures.

### Information about the Study Area

- a. Maitama District:** Maitama District has land coverage of approximately 1,050 hectares made up of six neighbourhoods with 469 residential plots. It accommodates the most exquisitely developed residential and commercial buildings in Abuja.
- b. Asokoro District:** Asokoro District is a low density development area occupying approximately 879 hectares with 4 neighbourhoods and 416 residential plots. The district houses most State, Federal and Foreign Government lodges.
- c. Central Area:** The Central Area covers an area of 1,658 hectares which is made up of the Three-Arm Zone (seat of Government), Government offices and Ministries and the Central Business District, which houses private commercial activities. It is designed for high rise buildings of between six and twelve floors.
- d. Wuse District:** Wuse District has land coverage of approximately 1,530 hectares comprising 15 neighbourhoods and 1,059 residential plots. Each neighbourhood has a centre which provides auxiliary services such as Schools, Health Centres, Shops and Public Utilities for the residents. Wuse District is fully developed with buildings for various purposes.
- e. Garki District:** Garki District has land coverage of 865 hectares consisting of eight neighbourhoods and 1,754 residential plots. It has similar characteristics with Wuse District.

Source: NIBC (1998)

## RESULTS

One hundred (100) questionnaires were administered for the study, out of which ninety-four percent (94%) were completed with valid responses. The questionnaires returned were adequate for analysis as observed in Aibinu and Jagboro (2002). The problems observed with the central sewer system are presented in Tables 1. The commonly observed problems were Sanitary Sewer Overflows (SSO) and foul odours emanating from the sewer system. The result of the analysis shows that 100% of the respondents in Wuse I and II District observed SSOs, while 94% observed in Maitama and Asokoro. Ninety percent observed in Garki I and II with 53% in the Central Area. On the other hand, all respondents in Garki I and II perceived foul odours from the SSO. This was followed by Wuse I and II with 95%, Asokoro 94%, Maitama 80% and Central area 68%.

Table 1: Responses on types of problems observed by districts

District	Distribution of Responses			
	Sanitary Sewer Overflows	%	Foul Odours	%
Garki I and II	18	90	20	100
Wuse I and II	20	100	19	95
Maitama	17	94	16	80
Asokoro	16	94	16	94
Central Area	10	53	13	68

Table 2: Location of occurrence of SSOs

District	Sewer lines		Manholes		Others		Σ Frequency
	Frequency	%	Frequency	%	Frequency	%	
Garki I and II	1	6	16	89	1	6	18
Wuse I and II	1	5	19	95	0	0	20
Maitama	0	0	16	94	1	6	17
Asokoro	1	6	14	88	1	6	16
Central Area	0	0	10	100	0	0	10

Table 3: Location of occurrence of odours

District	Sewer lines		Manholes		Others		Σ Frequency
	Frequency	%	Frequency	%	Frequency	%	
Garki I and II	1	5	17	85	2	10	20
Wuse I and II	2	10	18	90	0	0	20
Maitama	1	6	17	94	0	0	18
Asokoro	1	6	15	88	1	6	17
Central Area	3	15	16	84	0	0	19

Table 2 shows that most of the respondents observed the highest frequency of SSOs at manholes, compared to sewer lines or any other point of the sewage system. In the same vein, majority of the perceived foul odours emanated from manholes also. This data is presented in Table 3. These observations cut across all the five districts. The frequencies of occurrence of SSOs as observed by the respondents are shown in Table 4 and that of foul odours in Table 5. Most respondents across the five district felt SSO occurrences occurred ‘not often’ though respondents in Wuse I and II felt it occurred more often than not. With respect to odours, a larger number perceived foul smells ‘often’, with Garki I and II and Wuse I and II recording high percentages for ‘very often’.

Table 4: Frequency of occurrence of SSO

District	Very often		Often		Not Often		Not at all		Σ Freq
	Freq	%	Freq	%	Freq	%	Freq	%	
Garki I and II	2	11	7	39	9	50	0	0	18
Wuse I and II	5	25	8	40	7	35	0	0	20
Maitama	1	6	5	29	9	53	2	12	17
Asokoro	0	0	5	31	10	63	1	6	16
Central Area	0	0	3	30	7	70	0	0	10

Table 5: Frequency of occurrence of odours

District	Very often		Often		Not Often		Not at all		Σ Freq
	Freq	%	Freq	%	Freq	%	Freq	%	
Garki I and II	8	40	8	40	4	20	0	0	20
Wuse I and II	7	35	10	50	3	15	0	0	20
Maitama	1	6	9	50	8	44	0	0	18
Asokoro	1	6	8	47	8	47	0	0	17
Central Area	1	5	6	32	12	63	0	0	19



Table 6: Frequency of reporting sewer faults

District	SSO occurrence		Foul Odours	
	Frequency	%	Frequency	%
Garki I and II	3	17	0	0
Wuse I and II	2	10	1	5
Maitama	3	18	3	17
Asokoro	1	6	1	6
Central Area	2	20	1	5

Overall, most respondents showed a poor attitude to reporting the observed faults to the necessary authorities. Table 6 shows that only 20% respondents in the Central Area and 18% in Maitama reported faults of SSO to the operators while most of the respondents who reported foul odours were resident in Maitama. Some respondents claimed not to have idea of where to report SSO occurrences while others thought the system is monitored by the operator digitally.

Table 7: Frequencies of sanitary sewer overflow maintenance

District	Very often		Often		Not Often		Not at all		Σ Freq
	Freq	%	Freq	%	Freq	%	Freq	%	
Garki I and II	1	6	2	11	9	50	6	33	18
Wuse I and II	1	5	4	20	7	35	8	40	20
Maitama	2	12	2	12	8	47	5	29	17
Asokoro	1	6	3	19	7	44	5	31	16
Central Area	1	10	3	30	6	60	0	0	10

Tables 7 and 8 shows the results obtained for frequencies of maintenance of SSOs and foul odours in the five (5) districts. Majority claimed maintenance for SSOs was 'not often' carried out and a fairly high percentage claimed that it was not carried out at all. For odour control, a vast majority had not observed any activity at all to stop the foul smells. A fairly high percentage felt such measures were not carried out often enough.

Table 8: Frequencies of odour control activities

District	Very often		Often		Not Often		Not at all		Σ Freq
	Freq	%	Freq	%	Freq	%	Freq	%	
Garki I and II	0	0	0	0	3	15	17	85	20
Wuse I and II	0	0	1	5	5	25	14	70	20
Maitama	0	0	0	0	7	39	11	61	18
Asokoro	0	0	0	0	3	18	14	82	17
Central Area	0	0	1	5	6	32	11	58	19

The respondents also rated the perceived condition of the sewers and manholes and majority felt they were in Good condition as depicted in Tables 9 and 10. Roughly 20% across all districts felt the condition of both was fair and a negligible number felt they were in bad shape.

Table 9: Perceived condition of the sewer lines

District	Good		Fair		Bad		Σ Freq
	Freq	%	Freq	%	Freq	%	
Garki I and II	15	75	4	20	1	5	20
Wuse I and II	16	80	4	20	0	0	20
Maitama	15	83	3	17	0	0	18
Asokoro	15	88	1	6	1	6	17
Central Area	14	74	4	21	1	5	19

Table 10: Perceived condition of the manholes

District	Good		Fair		Bad		$\Sigma$ Freq
	Freq	%	Freq	%	Freq	%	
Garki I and II	13	65	5	25	2	10	20
Wuse I and II	14	70	5	25	1	5	20
Maitama	16	89	4	22	0	0	18
Asokoro	14	82	2	12	1	6	17
Central Area	15	79	3	16	1	5	19

Table 12: Effectiveness of sewer system for sewage collection and conveyance

SNo	Effectiveness Parameter	Rating /Frequency						Mean	Standard Deviation
		0	1	2	3	4	N*		
i	Sewage Collection and Conveyance	2	7	19	46	21	0	2.66	1.23
ii	System Operation and Maintenance	3	6	32	34	18	1	2.62	0.97
iii	SSO Occurrences	16	21	27	20	10	0	1.86	1.23
iv	Pollution Reduction	5	18	25	26	19	1	2.38	1.16
v	Foul Odour Problems	18	24	25	16	9	2	1.72	1.24

Legend: 0=Very Poor, 1=Poor, 2=Fair, 3=Good, 4=Very Good, N\*= No Response

Finally, several factors bordering on the effectiveness of the sewer system and perceived impacts of sewer faults on the environment and human health were ranked on a Likert type scale from 0 to 4, with 0 being the least effective/impact and 4 being the most effective/impact (as shown in the Legend of Tables 12 and 13). The respective means of each factor was computed and shows that the performance of the sewer with respect to sewage collection and conveyance, the system operation and maintenance and pollution reduction were deemed 'Fair' (or satisfactory). However SSOs and Foul Odours were rated poorly. With respect to environmental and health impacts, Surface water pollution seemed to be of greatest concern, followed by ground water pollution and environmental degradation. However, from the means computed, all the factors fell into the range of 'Very Low' to 'Moderate'. Several plates which show the nature of some of the problems associated with the sewer system is indicated in Appendix I.

Table 13: Perceived impact of sewer faults on the environment and human health

SNo	Effectiveness Parameter	Rating /Frequency						Mean	Standard Deviation
		0	1	2	3	4	N*		
i	Surface Water Pollution	22	26	30	11	2	3	1.40	1.05
ii	Ground Water Pollution	39	31	15	2	1	6	0.81	0.88
iii	Contamination of Drinking Water Sources	42	34	4	1	0	13	0.56	0.65
iv	Environmental Degradation	41	25	10	2	1	15	0.70	0.88
v	Air Pollution	21	15	42	8	6	2	0.53	0.66
vi	Outbreak of Diseases	46	31	5	1	0	11	0.41	0.52

Legend: 0= Very Low, 1= Low/Slightly Noticeable, 2= Moderate or Tolerable, 3= High or Irritable 4= Very High or Irritable, N\* = No Response

## DISCUSSION

From the results gathered, the commonly occurring problems observed with the sewer system by the respondents are Sanitary Sewer Overflows and foul odours which mostly occur at the manholes across all the five (5) districts of the study area. The respondents also claimed that mostly did not report faults observed with the sewer

system to any relevant authority. Routine maintenance of the system such as regular cleaning to remove debris that may lead to blockages, inspection of the sewers and monitoring activities of the system was carried out but was deemed unsatisfactory by the respondents, especially with respect to tackling foul odours. This shows that the routine maintenance programme can be significantly improved. However, the general condition of the sewer system was largely perceived as being in good shape. The respondents also seemed not too bothered that the perceived faults would have any significant environmental impact or health implications.

## CONCLUSION

From the results of the findings, it can be concluded that the sewer system in the Federal Capital City was assessed to be moderately effective in collecting and conveying sewage. However, fairly common occurrences of SSOs and foul odours are observed across all districts in the study. These occurrences are more common at the manholes than any other part of the sewer. Maintenance works are carried out, but not deemed sufficient by the respondents to deal with the observed faults.

## RECOMMENDATIONS

The following measures are recommended to increase the effectiveness of the sanitary sewers for sewage collection and conveyance in the Federal Capital City (FCC), Abuja:

1. The current system of service delivery should lay more emphasis on regular information gathering: collection system operations records, the maintenance and monitoring;
2. More attention should be accorded to inspecting the system by developing and implementing routine schedule inspection of the system, which is vital to proper maintenance for sewer collection system.
3. A plan to respond to Sanitary Sewer Overflows should be developed and implemented. Steps should be taken to contain and prevent sewer overflows into surface waters; and prompt notification of health agencies and other relevant agencies of all overflows should also be ensured. The inherent odour problems of the system should be addressed by providing hydrogen sulphide monitoring and control.
4. The System Owners and/or System Operators could employ a model of service delivery that will enable private sector participation in the operation and maintenance of the sanitary sewers. Such models may include sub-contracting the cleaning of the system and out-tasking the inspection of the system to specialist companies who have the proper tools and training.

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## **APPENDIX I: PLATES SHOWING SOME PROBLEMS ASSOCIATED WITH CENTRAL SEWAGE SYSTEM**



Plate 1: Sanitary System Overflows at Wuse District



Plate 2: Sanitary system overflow at Garki District

Plate 3: Incomplete sewer lines in the FCC





# RISK AND UNCERTAINTIES IN CONSTRUCTION CLIENTS' CASH FLOW FORECAST

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Accurate cash flow forecasting during tendering and execution of construction projects is essential particularly in helping the client to manage his finances. This has been difficult to achieve due to risk and uncertainties. This paper therefore evaluated the effect of risk and uncertainties on clients' cash flow forecast in Nigeria. The paper aimed at examining the occurrence frequency of risk and uncertainty factors and their effect on client cash flow forecast. One hundred and sixty copies of structured questionnaire were administered on quantity surveyors in private firms, public and corporate organizations, selected using systematic and purposive sampling techniques. The data collected were subjected to statistical analysis using factor analysis and relative significance index (RSI). Eight risk and uncertainty factors were extracted through factor analysis and they were client's brief consequence, nature of the project, tendering related and other extraneous factors, sum adjustment, clients' decision, economic related factors, external influence and valuation assessment. These reduced factors occurred frequently with high effect at diverse degrees when forecasting clients' cash flow. This result provides empirical information on factors which are germane to the occurrence of risk and its effect on clients' cash flow forecasts. It indicates the need for intensive effort by the construction participants in risk and cash flow management to proffer solution to the problem of escalating construction cost by giving due attention to risk.

Keywords: cash flow, forecast, client, risk, uncertainty.

## INTRODUCTION

Contractors and clients are more conscious of the value of good cash flow management as it improves financial position and removes risk of bankruptcy. Consequently, achieving an appropriate method of predicting an accurate cash flow pattern of a construction project in advance had been the concern of the construction contributors. There is a need for clients to know the pattern of their financial commitments as this will help with the provision of the fund and availability of working capital to fulfil contractual obligations for interim payments. It will also assist the client to monitor and ensure that the cost limit is not exceeded.

Peters (1984) acknowledged that the problems faced by the contractor in achieving precise cash flow prediction have received considerable attention while difficulties faced by the construction clients in this area have not been given the recognition they deserved. Therefore, there arose a need to consider the clients' cash flow forecast.

Different models have been developed to assist contractors and clients in forecasting cash flow. Khosrowshahi (1991); Kaka and Price (1991; 1993); Kaka (1996);

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Odeyinka and Lowe (2000a and 2000b); Kenley (2001); Hwee and Tiong (2002) and Odeyinka (2003) developed models to help contractors to solve the problem of limited time available for a detailed pretender cash flow forecast. However, these models aimed at the requirements of contractor rather than those of the client. The works of Sidwell and Rumball (1982), Peters (1984), Lowe (1987), Lowe and Lowe (1987, 1988) were among few models developed for the use of clients.

The importance of cash flow forecasting to both the contractors and construction clients has been well established. Laryea (2008) pointed out that risk is an important issue to contractors as well as clients and consultants of the industry. Ashworth (2004) established that all activities including construction involve an element of risk and uncertainties. The high business failure rates in construction industry records, according to Laryea (2008), may indicate that the industry has learned to master building but yet to master risk. Hence, an accurate forecast of construction cash flow has been a difficult issue due to risks and uncertainties inherent in construction (Onukwube, 2005).

Different methods have been adopted in modelling construction cash flow forecast by researchers but their accuracies were questionable because of failure to consider risks and uncertainties inherent in construction process. Accuracy of clients' cash flow forecast is unfeasible without giving adequate attention to certain requirements/factors that relate to the project, these various factors also include risk (Sidwell and Rumball, 1982; Peters, 1984; Lowe, 1987; Lowe and Lowe, 1987, 1988; Skitmore, 1992; Lam and Runeson, 1999 and Honoabu, 2005). This paper, therefore, determine the frequency of occurrence of these risk factors and their effect on clients' cash flow forecast.

## **CONSTRUCTION CLIENT CASH FLOW FORECASTING**

A cash flow forecast is a detailed projection of the timing and amounts of cash inflows and outflows for a specified time period, generally covering one year broken down into weekly or monthly time periods (Tremel, 2006). The concept of a cash flow forecast can be viewed from both the client's perspective and the contractor's perspective (Odeyinka and Ojo, 2007). Before or immediately after the commencement of site production, the client does not merely want the construction of the development project to evolve without a clear knowledge of the financial outlay (Kwakye, 1997). For this reason, the client's professional advisers provide information on when payments are due and an indication of how much is due, so that he may make the appropriate financial arrangements to meet the contractual obligations accordingly.

Provision of the capital investment required for construction projects to go ahead under most procurement methods is the responsibility of the construction clients. This money may be borrowed from banks, provided by shareholders' investments or generated from profits, or a combination of the three. According to Cooke and Williams (2004) cited by Odeyinka and Ojo (2007), the developer or construction client has a different view of cash flow from the contractor because their cash position is always negative until sales income or revenue from the completed building is forthcoming. The money in (or positive cash flow), according to Kenley (2003) and Cooke and Williams (2004), is derived from a number of sources including housing development deposits, sales from completed developments, rental income and production revenues while the money out (or negative cash flow) includes land purchase, interest on borrowings, planning and legal fees, professional fees, infrastructure costs and building costs.



## **RISK AND UNCERTAINTY FACTORS IN CONSTRUCTION CLIENTS' CASH FLOW FORECASTING**

Construction is often cited as a highly risk prone business because of the unique nature of the industry and its projects. There are various definitions of risk, disagreements still exist on the issues relating to definitions and what constitutes risk (Laryea, 2008). He was of the opinion that risk is generally focused on deviations from expected outcomes. Many writers differentiated 'risk' from 'uncertainty' (Smith, 1999 as well as Nworuh and Nwachukwu, (004), while others consider the terms to be synonymous (Laryea, 2008). To some, risks occur when either the outcomes or consequences of activities or decisions are less than certain, or at times both outcome and consequences can be uncertain. Risk in relation to construction is a variable in the process of construction project whose variation results in uncertainty as to the final cost, duration and quality of the project (Bufaied, 1987). However, Laryea (2008) agreed that risk is the exposure to the chances of occurrences of events adversely or favourably affecting project objectives as a consequence of uncertainty. Perry and Hayes (1985) asserted that the distinction between risk and uncertainty is of less or no importance when it comes to construction projects. It is implied from their views that risk is indistinguishable from uncertainty, therefore, they have the same end result.

Project activities experienced risks through risk factors which result in adverse effect. Various factors were identified by Khosrowshahi (2000), Harris and McCaffer (2001), Kaka and Price (1993), Kaka (1996), Odeyinka (2003), Okema (2005) and Laryea (2008), as affecting project objectives as a consequence of risk and uncertainty. They discovered that uncertainties are caused not only by project related problems but also by the economical and technological factors. Sidwell and Rumball (1982) identified building type, height, shape and design characteristics, external environmental influences, individual contractors pricing characteristics, weather etc as causes of low accuracy of predicted cash flow. Peters (1984) identified mode of payment, quality and reality of project programme, method of assessing interim payment, risk, level of required information, retention, currency of data, delay in honouring architect instruction and overestimating. Common consequences of project risks include cost overruns, time overruns, poor quality, and disputes among the parties to a construction contract. This paper therefore set out to determine the construction clients' risk related factors with a view to investigate their effect on the cash flow forecast.

### **RESEARCH METHOD**

The aim of this paper was achieved through administration of a detailed questionnaire survey to assess the frequency of occurrence of risk and uncertainty factors when predicting client's cash flow. A thorough literature review was initially conducted to identify the factors which were assessed by the construction industry clients.

These factors include unfavourable contract condition, inclement weather, obtaining the right amount of funds at reasonable interest rates, duration overrun, payment for re-measured works, changes in currency exchange rate and changes in interest rates. They also include provision for interim valuation, change in client's brief, complexity of work, overestimating, civil disturbances, adjustment of prime cost sum, adjustment of provisional sum, claims and variation to work. Others are over valuation, project characteristics, delay in delivery of major materials and components to the site, inflation, provision for fluctuation payments, deviation from programme schedule, delay of critical activities, force majeure, currency of data and government legislation.

The questionnaire was divided into two parts. The first part contained the general information about the respondents while the second part contained the total of 27 identified factors from the literature. A rating scale of 0-4 was used in the questionnaire to rate frequency of occurrence of each of these risk and uncertainty factors and their effect on clients' cash flow forecast. On this scale, most frequent/very high impact was represented by 4 and no occurrence / no impact was represented by 0.

The target clients were the private clients represented by the consultant Quantity Surveyors selected from the directories of Nigeria Institute of Quantity Surveyors (NIQS) and Quantity Surveyors Registration Board of Nigeria (QSRBN); the public clients represented by the public organizations with in-house Quantity Surveyors and corporate clients represented by the public organizations with in-house Quantity Surveying units. The copies of questionnaire were sent to 160 clients with a covering letter.

## DATA ANALYSIS AND RESULTS

Out of 160 questionnaires administered, 138 were returned giving a response rate of 86.25%. Data collected were subjected to factor analysis with each item treated as a variable with the aim of reducing them to few significant ones. These were tested for the appropriateness of factors extraction using Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy (MSA) and the Bartlett's test of sphericity. The result indicated that KMO value was 0.719 and Bartlett's test of sphericity was highly significant ( $\chi^2 = 938.129$ ,  $p < 0.05$ ) which confirmed the suitability of the factor extraction method used for the research.

Principal component analysis was also carried out, starting with the original data matrix resulting into principal factors extraction after interaction of communalities. Factors with eigenvalues greater than 1 were retained for rotation. Eight factors with a first dominant factor accounting for 23.9% of the observed variance were identified. All the eight factors accounted for 60.28% of the observed variance. This showed that the factors identified by factor analysis were significantly responsible for clients' cash flow forecast. In other words, 60.28% of the common variance shared by the 27 variables can be accounted for by the eight factors. This is reflective of the KMO of 0.719 as an adequate percentage of variance (Field, 2005). The factors are presented in Table 1.

The frequency of occurrence of the reduced factors and their effect on clients' cash flow forecast were examined using RSI. The result of the analysis was as presented in Table 2. The Relative Significance Index (RSI) was evaluated using the following expression:

$$RSI = \frac{\sum w}{A \times N} ; \quad (0 \leq \text{index} \leq 1)$$

where:  $w$  = weighting given to each factor by the respondents, and ranges from 4 to 0

$A$  = highest weight (i.e. 4 in this case) and

$N$  = total number of respondents.

Table 1 : Extracted risk factors through factor analysis with the loaded items

Component factors	Loaded items
1. Client' brief consequence	Delay of critical activities Deviation from programme schedule Duration overrun Variation to work Change in client's brief payment for re-measured works
2. Nature of the Project	Complexity of work Delay in delivery of major materials and components to the site Project characteristics Over valuation Force majeure
3. Tendering related and other extrogenous factor	Provision for fluctuation payments Tender unbalancing Civil disturbances Currency of data Force majeure
4. Sum adjustment	Adjustment of prime cost sum Adjustment of provisional sum
5. Clients' decision	Change in client's brief Obtaining the right amount of funds at reasonable interest rates Unfavourable contract condition Inclement weather
6. Economic related factors	Change in client's brief Changes in currency exchange rate Changes in interest rates
7. External influence	Inflation Claims Government legislation
8. Valuation assessment	Provision for interim payment Currency of data

Table 2: Mean RSI of the frequency of occurrence of reduced factors in client cash flow forecast and their effect

Reduced Factor	Frequency of occurrence		Effect of occurrence	
	Mean RSI	Rank	Mean RSI	Rank
Client' brief consequence	0.7206	1	0.7562	1
External influence	0.6613	2	0.7172	2
Valuation assessment	0.6444	3	0.6339	5
Sum adjustment	0.6357	4	0.5992	6
Economic related factors	0.6351	5	0.6764	3
Clients' decision	0.5864	6	0.6634	4
Nature of the project	0.5471	7	0.5826	7
Tendering related and other extrogenous factors	0.5297	8	0.5628	8

Table 2 showed that all the reduced factors have high RSI values (0.7206 – 0.5297) for frequency of occurrence and (0.7562 – 0.5628) for effect of occurrence. This implies that they occurred frequently with high effect on clients' cash flow forecast although with varying degrees. In addition, it is observed from the Table that Client'

brief consequence is the most frequent factor with highest effect on clients cash flow forecast (Mean RSI = 0.7206 and 0.7562 respectively) and closely followed by external influence (Mean RSI = 0.7081 and 0.7172 respectively). However, tendering related and other extrogenous factors tend to be the least frequent factor with lowest effect (Mean RSI = 0.5297 and 0.563 respectively).

The highly ranked factors, most especially factors such as the client's brief consequence, economic related factors and clients' decision are paramount to clients when taking decisions on proposed project. As such this should be carefully managed right from the onset. It is also observed from Table 2 that risk and uncertainty factors that occurred very frequently had very high effect on clients' cash flow forecast and factors with very low frequency of occurrence as well, had very low effect but the same order was not followed. For instance valuation assessment which was ranked 3<sup>rd</sup> in frequency of occurrence was ranked 5<sup>th</sup> when the effect of its occurrence was examined. Likewise, the order was not the same with sum adjustment, economic related factor and client decision. This was in conformity with the findings of Odeyinka (2003 and Odeyinka *et al*, (2008) that the order of extent of risk occurrence was not in the same order for the risk impacts.

The frequency of occurrence and effect showed the extent of their involvement in clients' cash flow forecasting and consequently determine the extent of the consideration to be given to them during cash flow prediction by the clients. The reason may be due to the fact that the clients surveyed were of the opinion that factors with high frequency of occurrence should be of more concern to the clients during cash flow forecasting in comparison with factors with low frequency of occurrence. Significant risk factors should be given adequate consideration by right from the planning stage in predicting the cash flow. The factors should not be singly considered but holistic approach should be applied to produce better result.

## CONCLUSION

This paper has systematically examined clients' risk-related factors associated with cash flow. Twenty-seven factors were identified and reduced to eight significant factors. The relative significance index developed in the paper provides an effective insight and clear picture of risk involved when predicting cash flow. It is suggested that risk which occurred frequently and with higher effect should be given high priority during consideration. This paper will enable better understanding of the occurrence frequency of different risk factors at the forecast level of cash flow by the construction clients. Such understanding is very essential for application of effective measure to reduce the effect of risk at pre-contract stage.

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# SAFETY ON GHANAIAN CONSTRUCTION SITES: THE ROLE OF THE EMPLOYER AND THE EMPLOYEE

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Construction sites are among the most dangerous workplaces. Statistics indicate high injury and fatality among construction workers in most parts of the world. This study examines the role of construction employers and employees in ensuring that the construction workplace is safe. Twenty (20) large scale contractors and 80 of their employees were interviewed using structured questionnaire to determine their knowledge of the various legislative provisions on occupational health and safety (OSH) and their contribution to ensuring that injuries and fatalities among construction employees are minimised. The results indicated that not all employers and employees are actively involved in eradicating unsafe practices on Ghanaian construction sites. The factors which contribute to this state of affairs include ignorance, apathy, lack of education and training, and lack of enforcement of laws relating OSH. The paper recommends a complete attitudinal change on the part of employers and employees and the development of a positive safety culture on all sites. It is also recommended that laws on OSH be enforced by those authorised to do so to ensure that employers and employees do become lax in their responsibility and that must motivate employees to behave safely.

Keywords: safety, construction site, responsibility.

## INTRODUCTION

It is common knowledge that the construction industry is one of the most dangerous and hazardous industries in the world (Suazo and Jaselskis, 1993). A review of the literature has established that the annual toll of accidents in the construction industry when compared to other industries in most countries of the world is high both in terms of cost and human suffering. Loosemore *et al.* (2003) found that in Europe construction accounts for over 15% of workplace accidents even though it represents less than 10% of the working population. In the US construction accounts for 19% of workplace fatalities, despite the fact that construction workers constitute only about 6% of the labour force. In Australia, 37.4 per 1,000 workers in the construction industry receive compensations for injuries and diseases, which is 63% higher than the all-industry average of 22.9. Haslam *et al.* (2005) also report that when accidents within the construction industry are collated with those of other industries, construction accounted for 31% of all work related deaths in 2002/03.

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Ironically, most of the causes of these accidents could have been avoided if proper safety measures had been adopted. According to Haslam *et al* (2005), the majority of construction fatalities in 2005 in the UK resulted from falls from height (46%) and struck by a moving vehicle (15%). Fall from heights and being struck by moving vehicles could be avoided if the necessary precautions are taken. The United States Department of Labour Bureau of Labour Statistics also reports that 1,226 construction workers die as a result of negligence in 2006.

The industry's poor safety record extends to Ghana as well. Statistics of construction industry accidents in Ghana from 2004 to 2009 illustrated in the Table below shows a worrying trend. Using 2004 as the baseline, accidents in the construction industry continue to rise from 8 in 2004 to 28 in 2009 (250%) rise.

Year	Number of accidents	Index
2004	8	100
2005	21	262.5
2006	29	362.5
2007	20	250
2008	30	375
2009	28	350

**Source:** National Labour Department, 2010

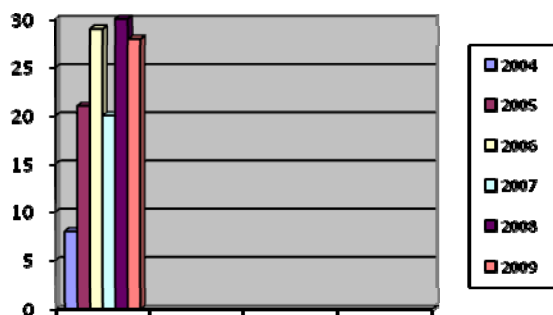


Figure 2: Trend of construction industry accidents

The construction industry continues to be the backbone of the Ghanaian economy. Its contribution to the Gross Domestic Product is about 8.5% (Ghana Statistical Service, 2007) and in 2003 it employed about 2.3 % of the economically active population (Amankwa, 2003). The construction industry plays an important role in any infrastructure related sector including water and sanitation. The economic benefits of the industry cut across all sectors. It has many economic spill-overs. Its benefits are not only financial, but social as well. Construction creates employment improves and an improved quality of life (Larcher and Sohail, 1999).

The Ghanaian construction industry like many developing countries is labour intensive and will continue to be so for a long time. This labour intensive



characteristic has increased the human exposure to increased health and safety hazards. It is in this light, that occupational health and safety of construction employees assumes a colossal importance for all stakeholders in the construction industry. It is absolutely important to improve the unacceptable poor safety record of the industry by taking effective action to minimize the risk of accidents and ill-health.

## **LEGISLATIVE PROVISION FOR OCCUPATIONAL HEALTH AND SAFETY OF GHANAIAN CONSTRUCTION WORKERS**

The government of Ghana has introduced Acts (e.g., Labour Act, 2003, Act 651 and Factories, shops and offices Act 1970, Act 328) to protect the health, safety and welfare of all industrial workers. The Labour Act, for example, makes it obligatory for the employer to “ensure that every worker employed by him or her works under satisfactory, safe and healthy conditions (Labour Act, 2003 Act 651, Article 118:1) and for the employee to “use the safety appliances, fire-fighting equipment and personal protective equipment provided by the employer in compliance with the employer’s instructions (Labour Act, 2003 Act 651, Article 118:3).

The employers’ obligation under the Labour Act includes setting standards to safeguard the wellbeing of their employees, providing personal protection equipment, and providing necessary information, supervision and training consistent with the level of literacy of the employees. Furthermore, the Act requires employers to report the occurrence of occupational accidents to appropriate government agencies.

Employees are obligated to exercise their actions with reasonable care as they go about their normal jobs at their workplaces to ensure their safety and the safety of others. Where danger exists it is the responsibility of an employee to report the matter to enable steps to be taken to neutralize it while at the same time removing himself or herself from the dangerous situation.

## **RESEARCH OBJECTIVE**

As already established, the health, safety and welfare of construction workers is the responsibility of both the contractor and the worker. The purpose of this study is to determine the extent to which contractors and employees understand their responsibilities in this regard and whether or not they are living up to their responsibilities.

## **RESEARCH METHOD**

Two sets of survey instruments were designed one for the employer and the other for the employee. The instruments incorporate both close-ended and open-ended response options. The closed-ended responses provided the opportunity for the respondents to show their understanding of issues related to the health and safety of workers as required by law. The open-ended response options allowed the respondents to provide additional insight or related information.

The instrument was structured to obtain information on the following:

- Company data: General information, including type of organization, annual construction volume etc.
- Respondents’ understanding of the concept of safety
- Knowledge of legislative requirements on health and safety of workers
- Personal responsibility in promoting site safety.

A purposive sample of 20 general contractors and four employees from each of the firms were selected from five Regional Capital of Ghana, Kumasi, Accra, Cape Coast, Takoradi and Sunyani, where there is a high concentration of contractors. Out of the 20 questionnaire distributed to contractors fourteen (14) (70%) were retrieved. Out of the 80 questionnaire administered to employees, 56 were returned (70%). Purposive sampling is non-probability sampling which is based entirely on judgment of the researcher, in that a sample is composed of elements which contain the most characteristic, representative or typical attributes of the population (Strydom and Devos, 1998). The disadvantage of this approach is its tremendous potential for personal bias (Panneerselvam, 2008). However, considering that this is a preliminary study, purposive sampling was considered appropriate.

## ANALYSIS AND DISCUSSION OF RESULTS

### Characteristics of respondents

All the contractors interviewed were the Directors of large and medium scale companies (D1/K1 and D2/K2) with at least 10 years experience in the construction industry. The employees consisted of 60% fulltime workers and 40% casual workers. They belonged to various classes of trades but had been with their companies for at least five (5) years in the case of fulltime employees and two (2) years for casual labourers.

### Responses by contractors

#### 5.2.1 Understanding of safety

Choosing from the answer options provided, 50% of the contractors said it is the state of being safe from danger, harm, risk and hazard, 30% said it is the state of being certain that adverse effects would not be caused by some agents under defined conditions whilst the remaining 20% said it is the doing or putting in place measures to prevent disaster and injury whilst ensuring comfort and convenience. All the respondents showed understanding of what safety is involved.

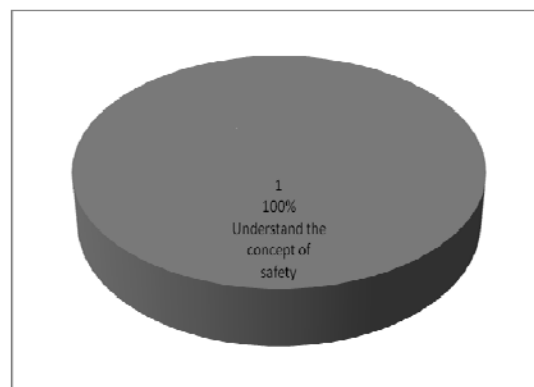


Figure 3: Understanding of concept of safety

It is very encouraging that all the respondents have some understanding of the concepts of safety. It is a good basis for a sound safety culture development on Ghanaian construction sites.

#### 5.2.2 Knowledge of the existence of legislative instruments on occupational health and safety

The responses established that all twenty contractors have knowledge of the existence of Factories, Offices, and Shop Act 1970, Act 323 and Labour Act 2003, Act 651. Based on a follow up question 75% said they had a passable understanding of the content of the Acts whilst 25% had no idea. (See Figure 3)

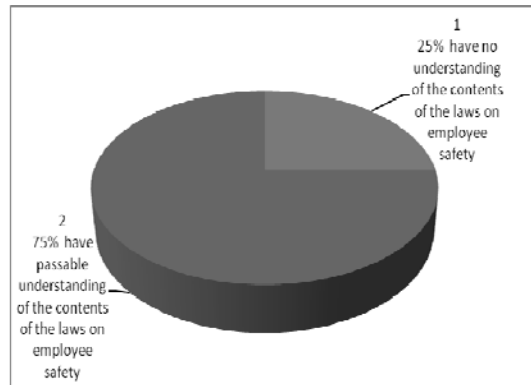


Figure 4: Knowledge of the content of legislative instruments on safety

Even though the result of this research cannot be generalised, it might be a pointer to the level of ignorance that exists in the industry concerning the requirements of the law on occupational health and safety. It is also an indication of the flagrant disregard for the Factories, Offices and Shops Act, 1970 Act 328 which requires that copies of regulations made under the Act which are in force on building sites should be posted at prominent positions on the site [Factories, Offices and Shops Act, 1970, Act 328: 8(1)]. This is a big challenge which must be addressed by the industry.

#### 5.2.3 Achieving safety of construction site employees

Regarding measures necessary for the health and safety of construction site employees, all the twenty contractors were unanimous that the safety of employees can be achieved by:

- providing and maintaining a safe working environment;
- ensuring safe access to and from the place of work;
- providing employees with the necessary information, instruction, training and supervision to ensure safe working habits;
- providing and maintaining safe machinery, equipment and method of work; and
- preparing and issuing to employees current statement of the firm's safety policy.

#### 5.2.4 Responsibility for the provision of safety personal protective equipment

All the respondents agreed that the provision of safety clothing and gadgets is the responsibility of the contractor or management. A follow up question was asked to determine how often contractors provide safety gadgets and clothing for the employees. It was discovered that 50% of the respondents provided them always; 30% provided them sometimes and 20% rarely. (Figure 4)

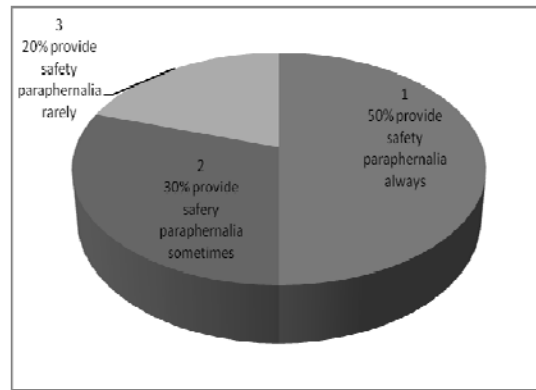


Figure 5: Frequency of providing safety personal protective equipment to employees

This result is an indication of the lack of commitment of some employers to the health and safety of their employees. It also shows non-adherence to the prescriptions of the legislative instructions on the occupational health and safety of construction employees.

#### 5.2.5 Types of personal protective equipment provided by employers

The responses established that some contractors provide the following safety gadgets:

- boots
- helmet
- goggles
- hand gloves
- ear protectors/eye protectors
- caution tapes/caution bands,
- nose guard
- reflective jackets and overcoats.

#### 5.2.6 Usage of safety personal protective equipment by employees

As illustrated in Figure 5, 55% of contractors said their employees use the personal protective equipment provided whilst 45% said their employees only use them occasionally.

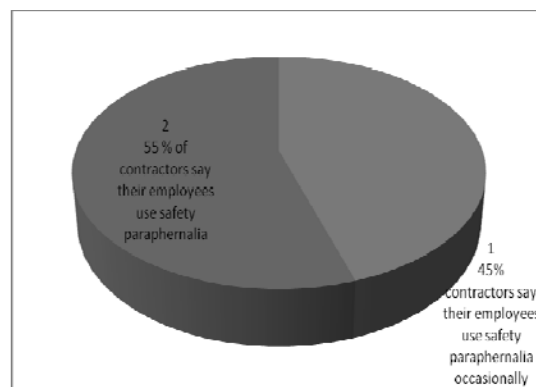


Figure 6: Usage of safety personal protective equipment by employees

The fact that some workers fail to wear their personal protective equipment all the time could be an indication that some employers or contractors are permissive and do not insist that the right thing is done. The non enforcement of safety rules by contractors could be the contributory factor to the indifferent attitude and risky

behaviour among some workers. This finding supports the assertion by van der Molen *et al.*, 2007 that regulation alone cannot reduce accidents in the construction industry and that regulations must have supplementary strategies to enforce the compliance of employers and workers to safety measures as prescribed by the regulation.

#### 5.2.7 Frequency of safety educations on sites

In responding to questions on safety education programmes, 45% of the contractors said they organize safety programs for their workers once in every month, 40% said they do so once in every year whilst the remaining 15% said they do it occasionally. The investigations revealed that programmes organized include personal safety and correct use of tools, plant and equipment.

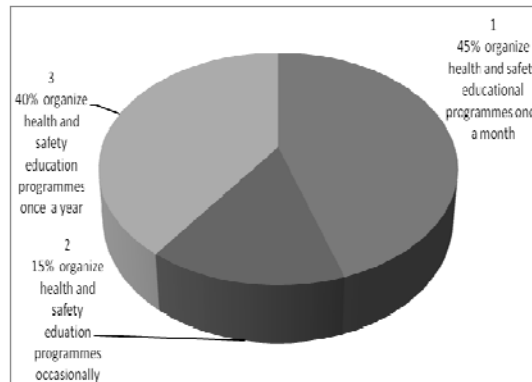


Figure 7: Frequency of safety education

From the responses it can be assumed that some amount health and safety education of workers is going on in the construction industry. However, whether or not the education is effective is a matter for further research.

#### 5.2.8 Motivating safe behaviour of employees

While seventy-five percent (75%) of the contractors provide cash incentives and certificates of recognition for safe behaviour of workers, twenty-five percent (25%) do not. It was further established that in the event of unsafe behaviour of employees 60% of contractors give further education to culprits, 30% suspend such employees whilst the remaining 10% impose fine which are deducted from workers salaries.

The use positive reinforcements (both monetary and non-monetary rewards) have been found to be effective in fostering safe work behaviour among construction workers in Singapore. Imposing fine was also found to be effective (Ai Lin Teo *et al* 2005).

#### 5.2.9 Publication of safety regulations and policies of company

All the respondents indicated that their safety regulations and policies are known to their employees.

It is not enough to have policies; policies must be communicated to employees in ways and manner they will understand. It is also important to engage and involve them in the policy formulation so that they can own and police the policies.

#### 5.2.10 Documentation of accidents

Only 45% of the respondents record accidents; 55% do not. Among those who record accidents 45% use the records as basis for designing educational programmes for their employees. The remaining 55% did indicate that they do nothing with the records.

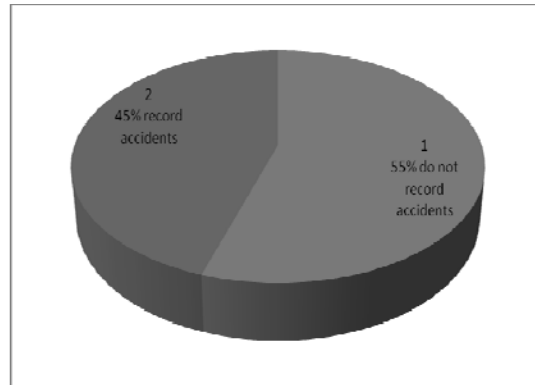


Figure 8: Documentation of accidents by respondents

Detailed information about accidents will help in learning and understanding the causes so that strategies can be developed to prevent future occurrence. In a research sponsored by Health and Safety Executive (HSE, 2009), into the underlying causes of fatal accidents, a substantial number of respondents from all the stakeholder groups acknowledged the importance of learning from accidents and particularly from the underlying causes. What is more, failure to document or report accidents to the appropriate authorities is against the law [Factories, Offices and Shops Act, 1970, Act 328: 10(1)]

## Responses by employees

### 5.3.1 Reasons for not using personal protective equipment

The survey revealed that 50% of respondents do not use personal protective equipment because they do not think they add anything to their safety. One respondent expressed a fatalistic view; “accidents will happen even if you are clad in safety garments.” The remaining fifty percent (50%) use the personal protective equipment but not religiously for a number of reasons: “I am not used to it.” “I don’t feel comfortable in them.”

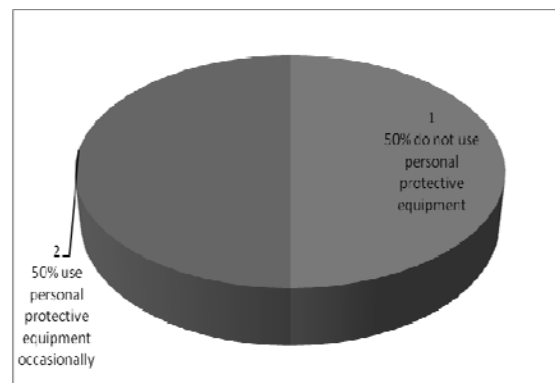


Figure 9: Reasons for not using safety personal protective equipment

To get workers to appreciate the dangers involved in not using personal protective clothing there must be a complete change of mindset and attitudes through education and training. There must be a deliberate effort on the part of management of

construction companies to establish a positive culture of safety. The problem often arises when casual labourers with no previous safety consciousness are engaged. It is important to orient and train such employees to accept the company's ethos on safety.

### 5.3.2 Employee's obligation to ensure safe working environment

Regarding knowledge of their obligation under the law to observe safety practices on site, 95% said they know they are obliged whilst 5% said they do not know.

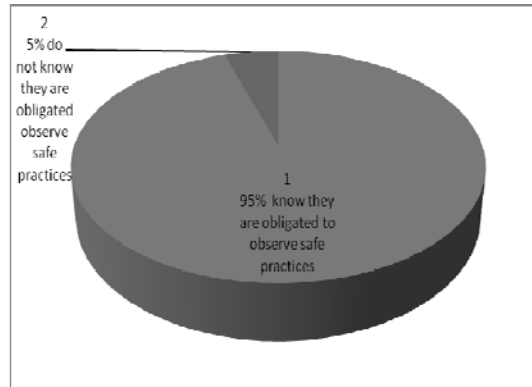


Figure 10: Employees' knowledge of their obligation to ensure safe behaviour

This response underscores the fact that knowledge is one thing and habit is another. It is not enough to obtain knowledge but knowledge must lead to the habits through practice. Again, it could be assumed that some contractors have not taken education and training of employees on health and safety issues seriously.

### 5.3.3 Unsafe behaviour of workers on site

Thirty-five percent of (35%) of the employees attribute their unsafe behaviour to ignorance of the consequences of such behaviour, 20% said they did know which behaviours were regarded as unsafe and still 45% suggested that lack of basic behavioural training was the cause of unsafe behaviour among employees.

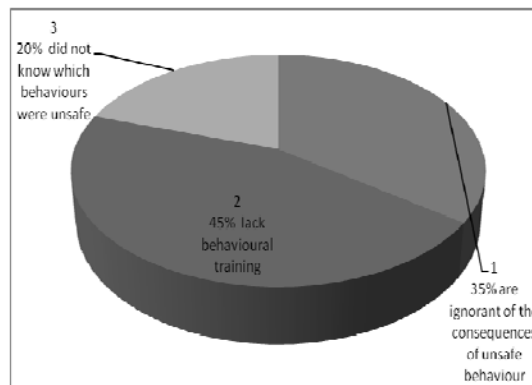


Figure 11: Reasons for unsafe behaviour of employees

### 5.3.4 Motivating safe behaviour on site

When asked to proffer suggestions for motivating safe behaviour among employees on site, 20% was reward as motivating factors, 20% recommended punitive action against culprits and the majority, 60%, saw education as the best method to encourage safe behaviour of construction workers.

### 5.3.5 The role of employer in improving safety on site

The employees volunteer the following suggestions as the responsibility of the employer for improving safety on construction sites:

- the provision of adequate safety personal protective equipment for workers
- encourage workers to use safety clothing
- educate regularly all workers to ensure full compliance with safety regulations
- police the regulations to make sure that all employees conform to safety standards
- workers must be motivated through the institution of awards for the best safety behaviours.

## CONCLUSIONS AND RECOMMENDATIONS

Safety on construction sites is the responsibility of the employer and the employee. It is explicit in the laws on health and safety in Ghana. However, the research has established a pointer to the possibility of general laxity among employers and employees on this vital issue. The factors which may have contributed to this state of affairs as discovered in the research include ignorance, apathy, lack of education and training, and lack of enforcement of laws relating OSH. The following recommendations are offered to ensure employers and employees play their roles to ensure health and safety on Ghanaian construction sites:

Regular safety education and awareness programs should be organized by employers for employees.

Safety officers must be appointed on every site. On small projects it can be the responsibility of trade- foremen but on large projects a fulltime safety officer should be appointed. It is will be there responsibility to closely monitor the behaviour of the workers.

Register of accidents should be provided to be used as a tool for training

The inspectorate division of District, Municipal and Metropolitan councils should strictly enforce the Health and Safety regulations and punish those contractors found to be flouting the laws.

Positive reinforcement in the form of monetary rewards and non-monetary incentives must be instituted by employers to foster safe work behaviour among employees.

Negative reinforcement in the form of close supervision, suspension from work and fines must be added to modify behaviour.

Employers must openly show commitment to the health and safety of employees and this attitude will trickle to the employees.

All companies must have positive safety culture and every employee must buy into it. There must be a systematic mindset changing from the present indifferent attitude to health and safety consciousness.

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# STRUCTURAL STABILITY IN NIGERIA AND WORSENING ENVIRONMENTAL DISORDER: THE WAY FORWARD

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Nigeria, as a developing nation, has been transiting through a great transformational state within the last couple of decades. The built environment is not left out in this process. The construction of houses and infrastructures are next essential to man as air, water and food. They serve as residence, places of work, worship, entertainment etc or as means of transportation. In the recent years, the stability of buildings and roads are experiencing a lot of challenges especially within the coastal areas. The rate of building collapse has been so alarming that a week hardly passes without a case being reported. Just a one day non-stop rain fall is enough to hold the whole of Lagos State to a standstill as failed drainages and flooded-potholed roads make it impossible for most people to go about their activities. The situation is not much different on major highways outside Lagos where travellers are often trapped in traffic jams for hours. The cost of these collapses in terms of human life and economic waste cannot be over emphasized. As the effect of the global warming is beginning to take its toll in many parts of the world, the changes in our environment must be closely watched and taken into consideration. In light of these issues, this paper analyses the problems of structural stability in a worsening environmental setup and proffers solutions that will enable us cope with this alarming situation.

Keywords: building collapse, failed environment, unskilled artisan, global warming.

## INTRODUCTION

Since Nigeria obtained independence from Britain in the 1960, it has been striving to develop itself in every field of human endeavour not minding the obstacles that have been militating against the realization of most of the projects. Currently Nigeria is pursuing the “Vision 2020” as one of the strategies to become one of the top 20 economies by the year 2020. To be able to realize this vision, the nation has been advised by the Accenture, the official consultant on the vision to focus on the development of five key sectors of talent, capital, resources, consumers and innovations. This entails that the nation must equally embark on a massive housing and infrastructural development. As the quest to achieve the vision continues, the failure rate of the existing structures is not encouraging and must be addressed if the massive infrastructural and housing developments needed to achieve this vision will be realized.

The purpose of every construction work is to create a structural system that meets some needs. The engineer must design to avoid failure which could result in loss of life and property or damage to the environment. Normally in a constructed system, failure is not expected within the projected lifespan. But since structures have many

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similarities with human beings who can get old or sick (defects), failures do occur (Sobotie, 1996). Under normal circumstances, structures do fail over time as a result of design flaws, ageing, material fatigue, negligence, accidents, terrorist attacks, extreme operational and environmental conditions, and natural hazards such as floods, lightening, hurricane and earthquakes.

Cases of structural failures are now very frequent in Nigeria and it has become a permanent feature in Lagos and elsewhere in the country. We have apparently lost count of the number of these disasters involving buildings and infrastructures as the frequency becomes frightening. This preventable catastrophe cost innocent citizen their lives, enormous economic waste in terms of loss of investments, job, income, loss of trust and dignity, environmental disaster, etc.

The failures referred to in this paper is common to the roads, drainage systems, dams and buildings, though this research is mainly centred on buildings. This paper will highlight the basis for the realization of efficient structures that live up to expectations, what is obtainable on the ground in Nigeria and what need to be done in the Nigerian construction industry as to obtain quality end-products that can withstand the test of time and the unpredictable environmental changes traceable to the global warming.

## **WHAT IS EXPECTED FOR THE REALIZATION OF EFFICIENT STRUCTURES**

The design of any structure must satisfy the functional objectives of safety, serviceability and economy. The tools to enable the engineer to realize these objectives are his knowledge of structural mechanics, available research materials, government regulations, codes, his experience and professional knowledge. The structure must be safe under the worst system of loads, i.e. is ductile and can sustain the design loads and resist accidental loads caused by misuse, fire and natural hazards such as seismic actions. Under extreme loadings, damage to the structure can be localized and possible loss of lives reduced, but progressive and catastrophic collapse must not occur. Under the working load, the deformation of the structure must not impair the appearance, durability and performance of the structure.

A structure is assumed to have failed when it can no longer serve the purpose for which it was built. Structural failure can be total or partial. Failures can occur during construction or later in the course of the design life of the structure. Irrespective of the type of failure or the period in the lifetime of the structure that it occurs, the effects are always devastating for the wastage of precious human lives and economic resources that accompany it.

The causes of failure can be traced to the activities that take place in the following stages of a building process: conception and design stage, construction-supervision stage and post construction/service stage. For the performance of quality jobs in any stage of the building process, a high level of skill and professionalism is needed (Ayininuola and Olalusi, 2004).

### **Conception and design stage**

The conception phase is the planning and feasibility studies stage in which some professionals may assist the owner to evaluate the technical options available for the realization and advice on the feasible choice. The activities in this stage starts with the client's brief, specifying the use of the proposed structure and all his special

preferences and his financial disposition. Then, follows the collection of data on soil properties, topographical and environmental factors.

The design phase is the most technical part of the building process. The design starts with the creation of the structural form that must be environmentally friendly, legally acceptable, economically viable and compatible with the immediate and future usage. The basic requirements of safety, aesthetic, economy and constructability must be met for any good design, irrespective of the client's brief (Davison and Owens, 2003). The aesthetic part may be handled by an architect while the design engineers take care of the rest. They must be skilled in design, have a good knowledge of available construction materials, the appropriate structural form suitable for the case under study and the design codes applicable. At this stage, a robust structure capable of sustaining all the envisaged loads will be produced.

Under estimating any form of load poses a great danger to the life of the structure, while excessive over loading leads to waste. In fact, the factor of safety must not be excessive such that the cost of the structure does not become excessive without additional advantage. The consideration of environmental factors is very important and becomes more serious in the coastal areas. As the effects of the global warming is being felt around the world with the subsequent unpredictable whether fluctuation, the importance of environmental factors is destined to increase.

For the design to be rated high, it must be easily interpreted during the construction stage as to reduce to the barest minimal any conflict that might hamper the success of the project. Before the structure designed will be realized it must be approved by the appropriate government agencies vested with the power of enforcing the application of the code of practice.

The structure produced from this design is strictly for the loads considered, and should there be need to subject the structure to loads greater than the design loads, it will be essential for a certified engineer to redesign the structure for the new loads and make adequate strengthening on the structure before subjecting it to the new loads.

The final phase of this conception and design stage will include much of economic activities related to the construction phase such as estimation of material, human resources, time of execution of the project and the budget.

### **Construction-supervision Stage**

This is the physical construction and over-seeing of the structure designed in the previous stage. During this implementation stage, every effort is made to ensure compliance with design and specification. The activities that takes place within this stage is so numerous, and often conflicting with each other. The management of scheduling, materials, human and technical resources is often enormous such that only trained professionals can handle them. Certified Engineers, Architects and Builders and skilled artisans all have their respective roles in this phase. The quality assurance aspect must not be left out, otherwise the purpose of the whole project will be defeated. A certified engineer or his authorized agent must play good supervisory role during the construction to guarantee that the principal structures conform to the approved design. He must certify the starting and the completion of every strategic phase of the construction work as a guarantee that the recommended materials and specifications were adopted. Each structural element constructed must be allowed to attain the minimal statutory strength before proceeding to the next phase of the

construction. The time for the realization of the structure must not excessively exceed the appropriate time needed for the completion.

If some part of a structure is erected and then abandoned for a long time, most of the materials exposed to environmental agents deteriorates and loses strength. When the need to complete the structure occurs, it will be necessary to test the abandoned structure to verify if the strength is sufficient to carry the design loads otherwise a redesign by experienced engineer becomes inevitable. In fact, for the dangers being posed by the invisible internal defects, Non-Destructive Testing techniques is the most appropriate method to assess structural integrity in such cases (Ede, 2008). Failure to do this poses a great danger to the structure, the construction workers and the future users. At the completion of the construction work, a certificate of fitness for use is issued to the client to authorize the usage of the structure.

### **Post construction/ service stage**

This is stage in which the constructed facility serves the purpose for which it was built. It is expected to serve effectively the purpose for which it is built without causing any form of discomfort to the user. For a good usage of any built structures, a management and monitoring team must always be at hand to continuously assess the true state of the structure and then make recommendations for the maintenance. During this stage the structure is supposed to be subjected to preventive and general maintenance to keep it in a fit state so that it can absolve the function for which it was built. If the stress on the structure exceeds the maximum value envisaged in the design, then the structure must be redesigned and upgraded if there is no constraint for upgrading, otherwise it will be necessary to design and construct a new structure to absolve the increased stress. Where some environmental factors absent at the time of design and construction of the structure become very evident, it will be necessary to take adequate steps to limit the effects.

## **RESEARCH ON THE GENESIS OF STRUCTURAL FAILURES IN NIGERIA**

Structural collapse occurs all over the world. The rate of occurrence is low in the advanced nations where strict controls and the enforcement of the codes and high ethics of professionalism is the order of the day. Even under severe natural hazards such as earthquakes, catastrophic destructions are often curtailed for the ductility present in the structures. The extensive collapse and casualties verified in the recent earthquake in Haiti is related to the absence of ductility in most of their buildings, including the presidential palace. Recent earthquake in Italy of comparable magnitude produced far less damages when compared to the Haitian case.

In Nigeria many structural failures have occurred within the recent years. These failures can be found practically in all areas of built environment with the collapse of building topping the chart. While I was concluding this paper at the end of April 2010, a two-storey market plaza in Oshodi - Lagos, owned by the Lagos State Government collapsed, killing at least four persons and leaving many others wounded (Pointblank news, 2010). On the 2 October 2006, hundreds of people were rendered homeless in Nigeria's North Western Zamfara State when Barrage Dam collapsed, washing away more than 500 houses (Afrol News, 2006). On a regular basis, just a one day non-stop rain fall is enough to hold the whole of Lagos State to a standstill as failed drainages and flooded-potholed roads make it impossible for most people to go about their activities. Of the 65 cases of building collapse around Lagos and its environs that I

considered in this research, a total of 384 human casualties were reported while the number of injured were numerous.

One of the most pathetic issues concerning these collapses is that not all the cases are brought to the knowledge of the public. When they occur in remote areas or in exclusive private environment, the matter often dies off there. Another issue is the quality of information that comes from the journalists after each collapse. Since most of them have no technical idea of structures, they go forth to release news and verdicts that are not compatible with the causes of the collapse. Passers-by without any idea of building technicalities gives immediate judgement, and conclusions are arrived at before any serious investigation takes place. Information from some professionals are often not encouraging neither. An accurate forensic analysis is needed to ascertain the true cause of most structural collapses.

The causes of these failures in the Nigerian built environment can be traced to abnormal factors not obtainable in most nations. Apart from the generally known causes of structural collapse such as design flaws, ageing, material fatigue, extreme operational and environmental conditions, accidents, terrorist attacks and natural hazards such as floods, lightening, hurricane and earthquakes, the principal causes of collapse in Nigeria include but not limited to non-adherence to the building codes, use of unskilled artisans, poor supervision, poor material, ignorance, lack of maintenance, overloading, conflicts among professionals, tendency to cheat and cut corners. As the world economic meltdown continues to bite harder in most part of the world, the spill-over effect continues to threaten various areas of our lives including the construction industry.

From the historical data collected for this research, it can be verified that the incidence of collapse has been on the increase from 1985 till date. Various papers have been written on this phenomenon, from Salau (1996) to Adeniregun (2010), all highlighting some of the causes and the possible solutions. Both the Governments are not left out in the quest to bring under control this ugly issue. But all the previous researches have failed to address the root cause of decadence in the Nigerian building industry and the unavoidable consequences of global climate change.

From my various researches, I have observed that the absence of standardized training programs for the craftsmen in the building industry remains one of the fundamental causes of defects in our structures which often culminate to collapse. The information got during this research showed that over 80% of the artisans never had a certified technical training on the jobs they perform at the sites.

In fact, the Government trade centres that use to be the pride of the nation in producing craftsmen have eventually lost their glory as no much attention is paid to them. For this, the building industry is populated by road-side trained artisans, who have no technical idea of the works they are often called to do. Many contractors just recruit any one available for job without previous training and knowledge of the trades as long as it brings savings, without considering the impact it will have on the quality of the final job. The contractors make no effort to train their staffs, while the artisans strive to lay claims on skills they cannot demonstrate.

I cannot imagine any building I have entered in Nigeria, whether private or public building without immediately identifying very ugly defects. Whether the building is a brand new one or already existing for some time, there is always a type of defect or the other; if it is not structural, it will be electrical, or plumbing or stone finishing. These can be traced fundamentally to ignorance of many of the players in the field.

Then as ignorance intermixes with corruption, the situation goes out of control. The contractors tend most often to place profit first without any regard for the quality of work they offer. Unless the client is very knowledgeable of the quality of product he wants and endeavour to enforce it, he will end up paying for the highest quality and obtaining the least. The actual cost spent by clients for poor construction in Nigeria will in most case realize better structures elsewhere. Except in the cases where the client is also the contractor, the client ends up always obtaining a quality far below what he paid for. The ignorance factor have so much blinded the eyes of the people that they accept these defects as something normal as long as there is whitewash outside to make the building seem to be new. This culture of not paying attention to defects goes on to define our maintenance culture. As we are used to accepting defects as normal, we hardly know when it is time to maintain our structures until they arrive to complete collapse.

Shifting from the artisan base to the professionals involved in building process, a lot of anomalies were verified from recent researches carried out on practicing Architects, Structural Engineers, Builders, Town Planners and Contractors in Lagos and environs (Adeniregun, 2010). All the Town Planners and some of the Architects and Engineers considered in this paper work in the public establishment, while the rest are in the private sector. The issues that pertain to the certifications of the professionals involved in the Nigerian building industry, the request for approvals before site works begins and insistence on material test for projects were analyzed. 25 professionals from each group were considered in the research work. Table 1 shows information on practicing professionals that are registered in their professional bodies. Figure 1 shows the percentage variation.

Table 1: Practicing professionals registered with the professional bodies.

Professionals	Total sample	Number registered	Percentage registered
Architects	25	13	52%
Structural Engineers	25	25	100%
Builders	25	17	68%
Town Planners	25	0	0%
Contractors	25	12	48%

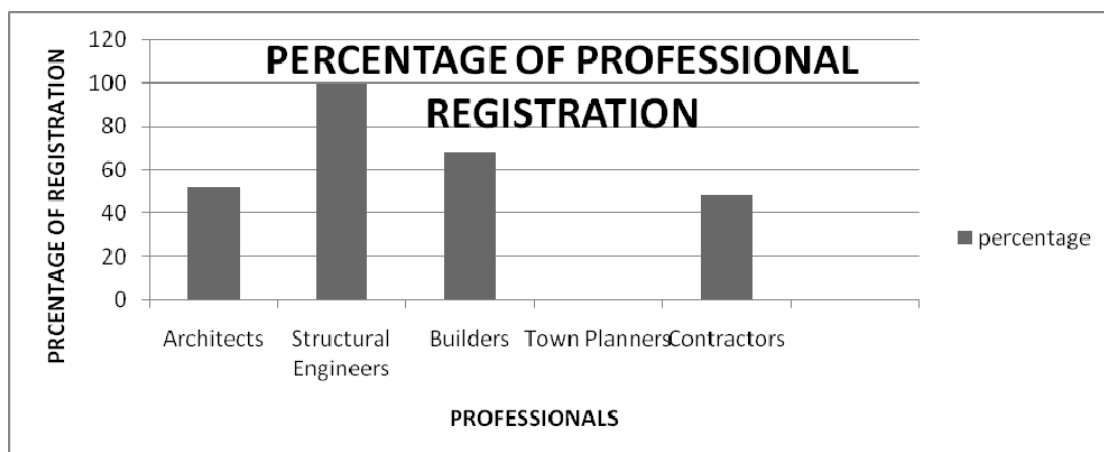


Figure 1: Percentage of professionals registered with the professional bodies.

Table 2 presents the percentage of professionals that seek approval before commencement of work at site. Table 3 shows the percentage of professionals that insist on material test before the commencement of projects.



Table 2: Percentage of professionals that seek approval before commencement of work at site

Professionals	Total sample	Percentage that seek approval before commencement of work
Architects	25	92%
Structural Engineers	25	100%
Builders	25	80%

Table 3: Percentage of professionals that insist on material test

Professionals	Total sample	Professionals that insist on material test	Percentage
Architects	25	25	100%
Structural Engineers	25	25	100%
Builders	25	17	68%
Contractors	25	12	48%

From the historical data considered for this research, information on the relationship between the heights of the building and rate of collapse can be seen in Figure 2, while figure 3 shows the monthly spread of the collapses and casualties.

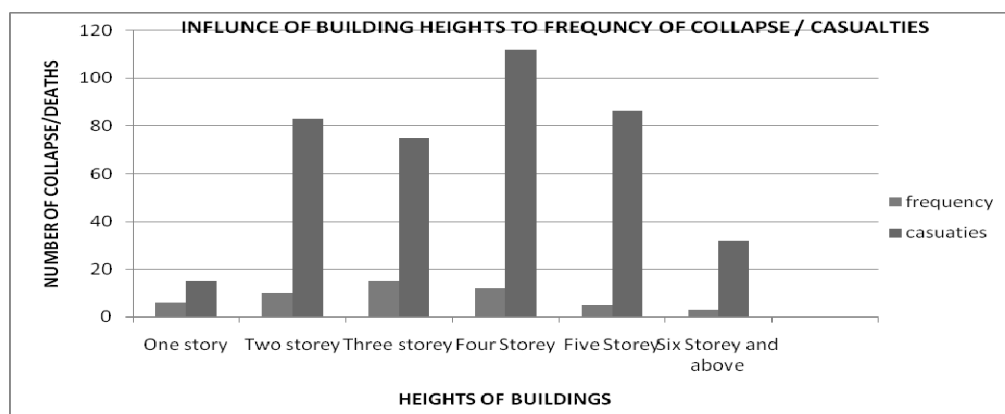


Figure 2: Variation of collapse with respect to the heights of the building

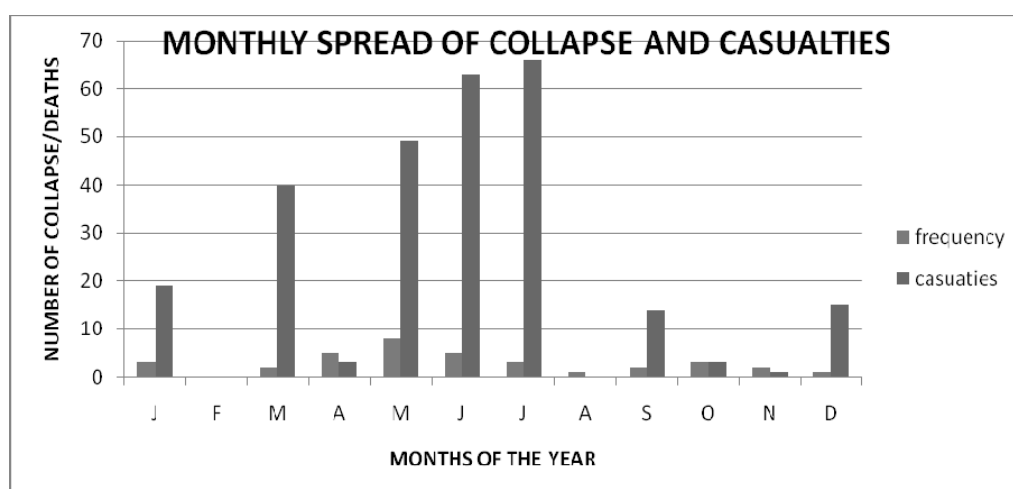


Figure 3: Period of collapse, frequency and casualty

Based on these results, it can be deduced that as the complexity in the building process/height increases (above 5 storey buildings), incidence of failure decreases. This can be attributed to the fact that the most common types of buildings realized are of lower heights. For higher heights, the quacks are forced out of the process as more reputable firms (often foreign firms) are brought into the process. This points to the fact that part of the causes are related to massive presence of unskilled labour and quacks in the field.

From the monthly spread, it can be said that the months of May, June and July are the most dangerous months (and this coincides with the peak of rainy season in Nigeria). It becomes evident that most of the causes of the collapses are water related problems alone or combined with other factors.

It is a known fact that the global climate change increases the rate and intensity of extreme weather events and a country like Nigeria will not be left out. These climate-related effects will be more serious in our long coastal frontier. The effects of changing climate are already evident across the length and breadth of the country. They include but not limited to gully erosions in the south eastern parts of the country, violent wind storms (many roofs were blown off in various part of the nation a couple months ago), rising sea level and flooding in various parts of the of the coastal areas of the country, indiscriminate damages to the few existing infrastructures, abnormal temperature fluctuation and different forms of social dislocation. As all these scenarios present themselves, we should expect a deterioration of the issues of building collapse in Nigeria should we not rise up to tackle them adequately.

## **RECOMMENDATIONS AND CONCLUSION**

Based on the aforementioned verifications, the following recommendations are made:

1. That the various governments and professional bodies gear up efforts towards offering free basic trainings to the artisans. That at least a trade centre to be established in each of the 774 local governments of the nation as to make them available to all that might need them. This is because with the help of skilled artisans, the very frequent cases of collapses during construction or brand new defective structures will be highly reduced. These artisans will be knowledgeable of the common materials and some basic building technicalities, and will therefore be in position to identify dangerous errors on time as to bring about correction before it is too late. After all, the very many existing structures of over 1000 years old in Europe were built by skilled artisans. In Nigeria most of the collapsed buildings are recent constructions or those still under construction. The very old ones collapse for lack of maintenance.
2. That all the professionals involved in the Nigerian building process intensify efforts towards affiliating and upgrading themselves technically through their respective professional bodies. The professionals must operate within their area of competence without crossing over to areas of lucrative specialised jobs where they have no skill. The Governments and the professional bodies should make efforts to identify and persecute the unregistered professionals and quacks operating in the various fields. This is because if the trained professionals operate illegally in the different fields of construction process, then they are inviting quacks into the profession and that will only aggravate the already delicate situation.

3. That construction activities be drastically reduced during the peak of rainy season (May to July) just in the same way construction activities are normally reduced in Europe during the adverse winter season and excessive rainy period.

The application of these measures in the building industry will enable us to start doing things right as to have more time and resources to prepare for the unpredictable weather deterioration emanating from the global warming and other greater challenges that await us. If we can bring the current rate of collapse under control, then we will be in better condition to confront any form of emergency that may come our way.

## **ACKNOWLEDGEMENT**

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# SUSTAINABILITY OF SOLAR HOME SYSTEMS FOR A DOMESTIC POWER SUPPLY IN NIGERIA

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The need for new energy infrastructure in Nigeria has long been established due to poor and unstable power supply. Thus, resulting in decrease of energy consumed to 0.075 toe/capita in 2007 when compared with World average of 1.78 toe/capita and African average of 0.68 toe/capita. Solar Home System (SHS) is one of the sustainable renewable energy source proposed to solve the problem surrounding the infrastructure. Perhaps, it is among the best options for Nigeria especially being in the tropics where there is so much sunshine to convert and in view of its apparent limitless potentials. Several researches on SHS are currently going on. Government and Non Governmental organizations (NGOs) are supporting demonstration and pilot projects to ensure that the general public becomes aware of the potentials of the technology. However, this study focused on assessing the availability (measure of readiness) of the source through field survey and experiments. In this work, we proposed to: determine optimum option of positioning photovoltaic (PV) panel for receiving sunshine, establish the electric power generating capability of the system with respect to solar sunshine intensity and duration, to develop SHS design criteria. Historical trends of solar radiation of some locations were collected, studied, analysed and presented as interim results to justify the proposed objectives of the study. This would provide potentials and valuable aid for sustainable development, enabling tighter control of power supply and greater efficiency in improving per capita energy consumption in built environment of Nigeria.

Keywords: sustainability, photovoltaic, solar energy.

## BACKGROUND

The development of any society is anchored on the steady supply of power towards attainment of comfort and human satisfaction within his immediate environment. This is not the case with Nigeria where power (electricity) supply is very erratic. Erratic power supply by National Electric Power Supply (NEPA) -now Power Holding Company of Nigeria (PHCN) has given cause for concern leading to the avalanche of generating sets for household and commercial uses in houses, streets and markets all over the country. Thus, the use of this generating sets are responsible for sizeable amount of air, water, soil and noise pollutions and these problems are particularly acute in urban areas.

Therefore, in terms of infrastructure, PHCN have not fared well in the discharge of its mandate. It has an installed generating capacity of 6,000MW, with peak national demand of 30,000MW and could provide maximum of 3,000MW with losses of 30-35% during transmission (Stanley, 2008; Hall, 2006). Though, Summary of the Nigerian Electricity Industry Scorecard for the First Half 2008 show a little

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improvement that, the total energy generated was 5,567,706MWH and 3,761,794MWH during the first and second quarter respectively, with losses of 10-20% during transmission (NERC,2008).

To this effect, in 2005 the Electric Power Sector Reform ACT (EPSR) was passed to liberalized the power sector and removed government's monopoly on generation and distribution. The Nigerian Electricity Regulatory Commission (NERC) was then established to create level playing field for all stakeholders and to license players in the sub sector in order to boost the power output in the country (Sambo, 2009). Hence, sustainable energy technologies (SETs) is the best alternative for the country because of the abundant renewable energy sources across the state and that will reduces the need for electricity management programs required.

Sustainable energy refers to a way we can generate and use energy that is more efficient and less harmful to the environment and without compromising the ability of future generations to meet their own needs. The most successful SETs programs focus on new products and techniques that have multiples benefit. Though, most renewable energy projects and production is large-scale, renewable technology are also suited to small off-grid applications, sometimes in rural and remote areas, where energy is often crucial in human development. Solar energy in this context refers to energy that is collected from sunlight and used for generating electricity using photovoltaic (PV) solar cells. Photovoltaic technology is the direct conversion of sunlight to electricity using semi-conductor devices called solar cells, which are almost maintenance free and seem to have a long life span. The longevity, simplicity and minimal resources used to produce electricity via PV make this a highly sustainable technology (SBTM, 1996). Solar photovoltaic applications have wider installation in Nigeria, it include solar photovoltaic water pumping systems, solar-powered vaccine refrigerators as well as telecommunication repeater stations powered by solar photovoltaic. There are also solar photovoltaic power plants that are providing electricity to entire villages and some specific projects such as rural health centres and television-viewing centres (Sambo, 2001).

The solar energy striking the earth's surface at any one time depends on weather conditions, as well as location and orientation of the surface. Thus, one of the most important requirements in the design of any solar energy conversion system is the information on the intensity of solar radiation at a given location. Such data are required in many applications ranging from design of photovoltaic systems, solar collector system and other building science. Solar collectors harvest solar energy in the form of heat while solar PV panels harvest solar energy in the form of electricity. solar collector make use of the greenhouse effect while solar PV panels convert radiant energy into electricity and are manufactured with varying electrical outputs ranging from a few watts to more than 100 watts of direct current (DC) electricity. For the developing countries (such as Nigeria) where there is an acute shortage of conventional source of energy, solar radiation data is still very scarce. However, many attempts have been made to develop models that can predict the amount of solar radiation available at a given place from a few input parameters (Gulma and Bajpai, 1983, Abah and Ochagwuba, 2001, Apabio et al, 2005, NASEF,2007, RISE, 2010)

This paper begins with exploring the need for sustainable development and essential requirements of the system, thereby motivation and need for the study was also highlighted. Methodology for the research was also described and the interim result used to justify solar radiation as the prerequisite to the sustainable power supply

through solar energy. In addition, hypotheses tested contributed to the identification of the ingredient data for rapid advancement of the SHS. Finally, conclusions were drawn on the intentions for SHS through availability of solar radiation and design criteria.

## SUSTAINABILITY OF SOLAR HOME SYSTEM (SHS)

Performance of system depend on its measure of effectiveness defined as “any set of criteria established to determine the resolution of critical issue” they are Reliability, Maintainability and Availability: defined as “a measure of the readiness of a system” also defined as “the probability that the system is operating satisfactorily at any time”, Hence, solar radiation is the mission in the availability study (Mbamali, 1997, Pyzdek, 2003). A great deal of emphasis is placed on quality of products and services, and reliability is a time oriented quality characteristic. There is a relationship between quality or customers’ satisfaction and measure of system effectiveness including reliability and maintainability. Costumers are concerned with the performance of the product over a time. Therefore, sustainability is essential in achieving such a mission more on the systems that fundamentally rely on natural sources (Solar energy) in accordance with certain indicators (Concise Encyclopedia of Engineering,2002).

Indicators of sustainable development are more in the nature of indices that reflect the state of overall concepts of social goals such as human development and quality of life or socioeconomic welfare. Sustainability was defined as “**an** approach to development that meets the basic needs of all people and has extending opportunities to satisfy their aspirations for a better life without compromising the ability of future generations to meet their own needs (Sachs 1978, WCED 1987, In: Mbamali, 2007, Moore 1996, Dal mato 2007).

Sambo (2009) opined the fact that, solar home system is one of such sustainable renewable energy source. Perhaps, the best for Nigeria especially being in the tropics where there is so much sunshine to convert. He then, called Government to; Strategies policy for continuous active support of research and development activities, Support demonstration and pilot project to ensure that the general public become aware of the potential of the technology. Nigeria has energy resource from solar radiation as given in the Renewable Energy Master plan (REMP) Table 1.

Table 1: Solar Radiation

Reserves (Natural Units)	Production Level (Natural Units)	Utilization (Natural Units)
3.5 – 7.0 KWh/m <sup>2</sup> /day (485.1 million MWh/day using 0.1% Nigeria land area)	Excess of 240 KWp of solar PV or 0.01 million MWh/day	Excess of 0.01 million MWph/day of solar PV

Source: REMP (2005)

Though, some limitations exist mainly due to variation of solar radiation over one day and over a year, therefore in the high latitude countries it is not viable to apply these systems (even at the present state of a solar technology). Cloud, limited visibility and weather patterns vary and attenuate the solar radiation in traversing the atmosphere, region that has generally cloud-free weather, such as dry regions to receive greater solar energy. Additionally, water vapour, haze, dust and other atmospheric contaminants tend to decrease the solar energy available at the earth’s surface. Hence, geographical location, climate and local conditions are the most important factors that

determine the possibilities of applying solar energy and other renewable methods of energy conversion (Gulma and Bajpai, 1983, Chwieduk, 2004, Akpabio et al, 2005, RISE, 2010).

The availability of more comprehensive solar radiation data is invaluable for the design and evaluation of solar based conversion systems. In many places of the world, particularly the developing countries, the basic solar radiation data for the surfaces of interests are not readily obtainable. Hence, photovoltaic modules are typically installed as arrays of modules with a fixed orientation depending on the site characteristics and cost constraints.

Therefore, solar tracking is a widely-applied proven technology that increases solar park production by directing photovoltaic or concentrated photovoltaic to follow the sun along its path from dawn until dusk, capturing the maximum solar radiation for the longest time possible. It also make a positive impact on the total gain of the whole system, causing the inverter to work as much time as possible at a better level of performance and minimise problems associated with susceptibility to dust and dirt that may cause drift in solar alignment (Gulma and Bajpai, 1983, Chwieduk, 2004, Akpabio et al, 2005, Iloeje, 2007, Li et al, 2008). This research work will study the effect of clouds and reduction in visibility that reduce the solar intensity below the value appropriate to any hour of any day in clear weather. Also, predict an estimated annual global solar radiation on the various positioning and orientations based on metrological records.

## **MOTIVATION AND NEED FOR THE STUDY**

The per Capita energy consumed (toe/capita) in Nigeria has been, from 0.153, 0.125, 0.089, and 0.079 for 2002, 2004, 2006 and 2007 respectively. These values when compared with the World average of 1.78 toe/capita and the average for Africa of 0.68 toe/capita, show a great merging southing an urgent attention. Hence, the energy supply mix in to the economy should also be diversified to include nuclear, coal, solar, wind and bio fuels (Sambo, 2009). NERC is currently exploring the resources available for sustainable power generation in Nigeria. They estimated an annual average of daily solar radiation to vary from as high as 7KW/m<sup>2</sup>/day in the northern border regions to as low as 3.5KW/m<sup>2</sup>/day in the coastal regions of south, and an annual average daily sunshine hours to vary from as high as greater than 8hrs/day in the northern border regions to as low as less than 6hrs/day in the coastal regions of south. It then classify the country with respect to availability of sunshine for Solar energy in to three classes; low, medium and high region (Iloeje, 2004, NERC, 2008).

The solar home system (components/accessories) seems to be too expensive since they are almost all imported, and lack of awareness has stalled the potentials. People are of the opinion that such innovations work in Europe or America a notion that has to be dispelled (NASEF, 2007). In view of the fact that, there are multiple power cut during the day. Businesses that rely on electricity become less efficient and lose profits as result of power losses. Indian government has no short-term plans rather, a small scale biogas generator was developed, and it run on different forms of biomass and serves a household in localized situation. It is reliable, cheap and sustainable alternative to or creator of electricity (Biogas Generator, 2008). Thus, there is a growing national and international interest in sustainability, there is also likely to be a greater focus on decoupling environmental pressures from economic growth through smatter consumption and greater resource efficiency in energy utilization, distribution and transmission management.



Technology Research Institute (TRI) under the Renewable Energy Technology in Asia (RETs) installed one Battery Charging Station (BCS) and five Solar Home Systems (SHS) in a village about 30km from the nearest grid electricity. This demonstrates use and benefit of the technology among the potential users, with improvement in quality of life, children education, income generation, and awareness of the technology among the rural people (TRI, 2001). It has been estimated that in year, each KW of solar power saves on tone of carbon dioxide emission (Fapetu, 2006). Therefore, research efforts to develop these alternative sources of energy should be intensified in the area of domestic power supply of electricity to a cluster of household and shops for both urban and rural homes in Nigeria. Two fundamental methods of solar energy conversion are photothermal and photoelectric. Thus, various aspect of SHS exist and solely depend on the design and application of the systems. Some are completely supplied by the energy converted by PV panel/arrays, some are supplemented by either grid line or generating set, while others uses battery charging stations (BCS) or other practical applications. However, other solar energy application include: water pump systems, water or space heating/cooling systems, power tower system and so on (SCI, 2000, TRI, 2001, Abah and Ochagwuba, 2001, Chwieduk, 2004, RISE, 2010).

NASEF (2007) outlined in its communiqué that, high initial capital investment, low public awareness, lack of appropriate institutional framework, regulatory and technical standard and local manufacturing of solar system components-solar pv panels are some of the challenges. Hence, recommends that National Energy Policy and the Masterplans should be institutionalized, promote public-private partnerships involving local and international energy institutions, donors and development partners, and strategies development for local processing/manufacturing of components. Therefore, this work aimed to assess the sustainability of Solar Home System (SHS) for a domestic power supply, with a view of developing the potentials and means of improving availability of sunshine and other essential requirement of the system in Nigeria. This would be achieved through determining optimum option of positioning PV panel for receiving sunshine, establishing the electric power generating capability of the system with respect to solar sunshine intensity and duration, and ultimately develop design criteria for sustainable SHS.

## RESEARCH METHOD

The research is still at the formative stages and carried out through extensive literature review to articulate the current trends of sustainability and global solar radiation. Field survey will consist of the use of checklist and administration of structured questionnaires to study and analyse the prospect and challenges of the systems (SHS). These will guide the development of experiment. Two sets of measurement on the availability of solar radiation under a fixed and tracking condition will also be carried out based on different positioning (latitudes) and orientations. Annual average intensity of solar radiation ( $\text{KWh/m}^2/\text{day}$ ) and average hours of sunshine ( $\text{hr/day}$ ) are the intended. Furthermore, the performance of a photovoltaic module will be studied thereby analyses the potentials of the system.

The data collection process begins with historical trends of solar radiation from Nigerian Metrological Agency (NIMET), it was analysed to predict the pattern of solar radiation of nine cities in Nigeria and are grouped to the three solar radiation zoning of ECN. Secondary data were also sorted for comparison of incident solar radiation of tracking and non tracking PV panels. Finally, energy conversion

efficiency of a PV panel was outlined. Statistical Package for Social Sciences (SPSS) was used for the following tests in the work.

One-way analysis of variance (ANOVA) test, to prove the null hypotheses that the annual average of solar sunshine duration and radiation in all the nine cities are the same. That is;  $H_0: \mu_{c1} = \mu_{c2} = \mu_{c3} \dots = \mu_{c9}$

$H_1: \mu_{c1} \neq \mu_{c2} \neq \mu_{c3} \dots \neq \mu_{c9}$  Criterion: Reject the null hypotheses if  $F > F_{0.05}$

Student t-statistics to determine whether the difference in the annual average of solar sunshine duration and radiation of each of the three zone is comparatively significant.

Criterion: Reject the t-test result if  $t > t_{0.025}$

Paired sample t-statistics to determine whether the difference in the tracking module radiation and a fixed inclined module radiation is significant.

Criterion: Reject the t-test result if  $t > t_{0.025}$

## INTERIM RESULTS

### Solar sunshine duration and radiation

A historical data collected from NIMET (appendix 1) shows the solar sunshine hours/day and solar radiation (MJ/M<sup>2</sup>/day) for nine cities across Nigeria for the month of January, 1971 to 1980. The solar sunshine hours/day and the radiation studied seem to be the same for almost all the cities. Therefore, the result of the ANOVA test on the solar sunshine duration (Appendix 1) indicates that  $F = 533.344 > F_{0.05}$  and similarly Solar intensity (Appendix 1) indicates that  $F = 32.08 > F_{0.05}$ . In both cases, the null hypothesis of equality was rejected and it was concluded that there is a significant difference in the annual solar sunshine duration and radiation. The result made it possible to examine further the differences based on the three zoning ( high, medium and low, see Appendix 1).

Table 2: Difference in solar sunshine duration and radiation between the zones

Solar sunshine duration (hours/day)			
	Two-tail t-statistic result	Degree of freedom	Remark
High VS Medium Zone	$t = 3.655 > t_{0.025}$	58	Significant
High VS Low Zone	$t = 3.255 > t_{0.025}$	56	Significant
Medium VS Low Zone	$t = 2.3585 > t_{0.025}$	56	Significant
Solar sunshine radiation (MJ/m <sup>2</sup> /day)			
	Two-tail t-statistic result	Degree of freedom	Remark
High VS Medium Zone	$t = 5.308 > t_{0.025}$	58	Significant
High VS Low Zone	$t = 6.354 > t_{0.025}$	58	Significant
Medium VS Low Zone	$t = 2.511 > t_{0.025}$	58	Significant

The difference in solar sunshine duration and radiation between the zones for the three cases high Vs medium, high VS low and medium VS low and the result of the t-tests on the level of significance of the variations are presented in table 2. The result shows

that the difference between the zones is significant in all the cases tested, therefore each zone would be treated independently in the design and installation of SHS. Though, further studies on the subsequent years historical data and the current data to be collected on these and subsequent cities would provide more decision ground for the design and installation.

## **COMPARISON OF TRACKING AND NON TRACKING ON INCIDENT SOLAR RADIATION**

Secondary data on the tracking and non tracking on incident solar radiation was sorted and analysed to determine whether the difference in the tracking module radiation and a fixed inclined module radiation is significant. The data was based on the use of Metrosol measuring instrument that record the maximum reading of solar energy density. (see Appendix 2).

The result shows that the difference in the tracking module radiation and a fixed inclined module radiation is significant based on the paired sample test with  $t = 6.145 > t_{0.025}$ .

Results shows that by tracking, some solar radiation could be measured almost 100% above either in the morning or late in the evening as in Appendix 2. However, by tracking the length of the sunny period for a day is about 13 hour which is about 1½ hour longer than that when no tracking is used. The energy conversion efficiency of the PV module used was also measured to be 10.2 % and is quite normal for the type of silicon cells used in the module. The efficiency depends to a great extent on the manufacturing process, materials used and the spectral distribution of the incident solar radiation (Gulma and Bajpai, 1983).

## **CONCLUSIONS**

This paper has reported some of the reasons why the energy infrastructure of Nigeria needs to be restructured and the best appropriate option in current age of Sustainable renewable energy technologies. It gives more attention to the sustainable indices available for Nigeria and considers the prediction of global solar radiation data as pre-requisite for SHS in any developing country like Nigeria. Solar sunshine Duration and radiation of some cities studied shows that zoning the country in to some zones for the design and installation of SHS is necessary for a viable and sustainable utilization of the potentials of the system. However, solar tracking is also essential for the sustenance despite the cost constraint, and that research development and demonstration should find the optimum option of the Positioning, Array, and orientation. Thus, subsequent study will provide optimum solution for the control of the factors responsible for predicting global solar radiation data and develop that of Nigeria according to their variation of zones. Ultimately, design criteria for Sustainable SHS would be developed in order to enhance domestic power supply in Nigeria.

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## Appendix 1: Solar sunshine durations and radiation of January 1971 to 1980

High zone of solar radiation of Nigeria [three (3) cities]

S/N	Year	Maiduguri 11.85° Lat.		Yola 09.14° Lat.		Sokoto 13.07° Lat.	
		Duration (hrs/day)	Radiation MJ/m <sup>2</sup> /day	Duration (hrs/day)	Radiation MJ/m <sup>2</sup> /day	Duration (hrs/day)	Radiation MJ/m <sup>2</sup> /day
1	1971	12.08	28.53	11.47	27.90	12.11	16.31
2	1972	12.07	29.19	11.47	27.10	12.10	16.69
3	1973	12.06	29.21	11.48	29.90	12.08	16.82
4	1974	12.05	28.59	11.48	26.40	12.07	16.72
5	1975	12.04	28.61	11.48	25.70	12.10	15.88
6	1976	12.03	26.61	11.48	27.80	12.05	17.66
7	1977	12.03	22.86	11.49	24.00	12.03	18.76
8	1978	12.02	18.34	11.49	20.30	12.02	21.06
9	1979	12.01	21.20	11.49	23.30	12.01	18.89
10	1980	12.00	23.72	11.50	25.10	12.00	19.21

Medium zone of solar radiation of Nigeria [three (3) cities]

S/N	Year	Jos 09.52° Lat.		Zaria 11.06° Lat.		Abuja 09.15° Lat.	
		Duration (hrs/day)	Radiation MJ/m <sup>2</sup> /day	Duration (hrs/day)	Radiation MJ/m <sup>2</sup> /day	Duration (hrs/day)	Radiation MJ/m <sup>2</sup> /day
1	1971	12.10	18.67	12.10	17.82	12.07	17.36
2	1972	12.07	19.11	12.08	17.27	12.07	17.61
3	1973	12.06	18.04	12.07	19.55	12.06	17.40
4	1974	12.05	15.54	12.06	18.42	12.05	15.96
5	1975	12.04	15.43	12.05	17.31	12.04	17.77
6	1976	12.03	18.20	12.04	16.62	12.03	18.56
7	1977	12.06	19.81	12.03	19.92	12.02	19.53
8	1978	12.02	20.13	12.02	21.10	12.01	19.55
9	1979	12.01	19.83	12.01	18.48	12.01	17.59
10	1980	12.00	19.15	12.00	21.03	12.00	16.02

Low zone of solar radiation of Nigeria [three (3) cities]

S/N	Year	Benin 06.19° Lat.		Ondo 07.10° Lat.		Lagos 06.35° Lat.	
		Duration (hrs/day)	Radiation MJ/m <sup>2</sup> /day	Duration (hrs/day)	Radiation MJ/m <sup>2</sup> /day	Duration (hrs/day)	Radiation MJ/m <sup>2</sup> /day
1	1971	12.05	20.28	12.06	16.23	12.05	11.05
2	1972	12.04	19.26	12.05	15.22	12.05	16.89
3	1973	12.04	19.39	12.05	16.14	12.04	15.65
4	1974	12.03	17.98	12.04	14.00	12.04	15.66
5	1975	12.03	19.00	12.02	16.04	12.03	14.31
6	1976	12.02	19.22	12.02	18.42	12.02	16.95
7	1977	12.02	20.48	12.02	17.52	12.02	19.23
8	1978	12.01	19.35	12.01	15.68	12.01	15.71
9	1979	12.00	17.81	12.01	17.55	12.00	14.35
10	1980	12.00	19.80	12.00	16.09	12.00	16.99

Note: for conversion  $1 \times 10^{-3}$  MJ equals  $1 \times 10^{-4}$  KW

Source: NIMET (2010)

## Appendix 2: Solar tracking radiation and a fixed inclined module radiation (12.5°) [8.30am-5.00pm]

Radiation on a tracking module (KW/m <sup>2</sup> )	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.7	0.6	0.5	0.5	0.3
Radiation on a fixed inclined module (KW/m <sup>2</sup> )	0.3	0.3	0.4	0.5	0.6	0.7	0.7	0.8	0.8	0.9	0.8	0.7	0.7	0.6	0.5	0.4	0.3	0.2

Note: Readings at interval of 30minutes Source: Gulma and Bajpai (1983)

# SUSTAINABLE CONSTRUCTION EDUCATION: ASSESSING THE ADEQUACY OF BUILT ENVIRONMENT PROFESSIONAL'S TRAINING

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The world's population continues to grow, creating the need for more buildings and public infrastructure, resulting in an increase in waste production, energy usage and water consumption. At current trends, the ability of future generations to adequately meet their needs will be significantly challenged. Lack of awareness and knowledge on sustainable construction by relevant practising professionals within the built environment in Nigeria has been identified as one of the barriers to ensuring sustainable construction. This study investigated the adequacy of tertiary institutions' training towards production of professionals, well grained in the tenets of sustainable construction. The study was carried out by using a checklist to benchmark existing curricula of five Built Environment professions in five Nigerian Universities. Also, a questionnaire was administered to establish familiarity of the built environment students and educators with the concept of sustainability. The results of the descriptive statistics presented the following findings: There are significant gaps in current university education as sustainability had not been explicitly considered in the curriculum. Familiarity is quite low among the respondents, particularly their understanding of the concept, key aspects of sustainability and sustainability assessment tools widely used in construction. Finally, lack of adequate knowledge/awareness, the problem of identifying sustainability issues relevant to course subjects and dearth of appropriately trained educators on sustainability were identified as factors hindering the incorporation of sustainability into the curriculum. The study recommends that relevant authorities update the curriculum of these programmes and provide educators with the platform to expand their knowledge.

Keywords: built environment, construction education, sustainable construction, university.

## INTRODUCTION

The construction industry, while contributing to overall socio-economic development of any country, is a major consumer of natural non-renewable resources and a polluter of the environment; it contributes to environmental degradation through resource depletion, energy consumption, air pollution and generation of waste in the acquisition of raw materials (Watuka and Aligula, 2003). Thorpe *et al*, (2008) observed that construction activities significantly impact on waste, energy use and greenhouse gas emissions. Around 50% of all global resources go into the construction industry, 50%

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of all global warming gas emissions is related to buildings, 45% of energy generated is used to power and maintain buildings, and 5% to construct them (CIOB, 2004).

According to Harman and Benjamin, (2004) the built environment is the heart of any economy; providing the infrastructure necessary to enhance productivity, but the manner in which it consumes natural resources makes it responsible for some of the most serious local and global environmental changes. Crossely, (2002) also stated that the construction industry is arguably one of the most resource-intensive and environmentally damaging industries in the world, which is unsustainable.

Nigeria, like many other developing countries is faced with the challenge of approaching construction in a more sustainable manner. Several studies by Dania et al (2007), Ogundele (2006), and Adebayo (2002) concluded that construction practices in Nigeria were not sustainable or embracing sustainable trends and attributed this to the poor grasp of the current crop of practising professionals on the subject and weak legislative controls.

Stephen *et al*, (2008) emphasised that institutions of higher learning are critically important places of production, perpetuation and dissemination of knowledge. These institutions around the world have recognized that they have a unique responsibility towards the goal of achieving sustainability. The University is the logical nexus for bringing together a diverse group of ideas on sustainability and finding ways to integrate the concept into relevant academic curricula.

Fostering a healthy, just and environmentally sustainable society will require a large shift in thinking, values and action - a change in mindset. Today's University students particularly those in the built environment disciplines will go on to become construction managers, lecturers and researchers amongst others. The degree to which these prospective professionals are prepared to deal with the procurement of the built environment as well as make decisions for a more sustainable future depends on the awareness, knowledge, skills and values they acquire during their requisite period of study in the university. Therefore, this paper focuses on appraising the adequacy of the training given to prospective built environment professionals in meeting the plethora of sustainable construction challenges.

## **SUSTAINABLE CONSTRUCTION EDUCATION**

Sustainable construction is "not a fad anymore; it's a megatrend" (Freemantle, 2002). In view of this, it has become necessary for construction managers to be knowledgeable in the various aspects of green building. Tinker et al, (2004) opined that to produce construction graduates who meet this need, it is necessary to retool programmes so that they incorporate green philosophies and techniques. According to Mead (2001), green education can easily be integrated into programmes either by incorporating green ideas into existing courses or by creating new courses that focus primarily on sustainable ideas.

Sustainable construction education for construction students has been studied by several scholars particularly in Australia, the United Kingdom, and United States. Mead (2002) defined the status of sustainable construction in the construction industry and suggested the importance of sustainable construction education in construction programmes in the United States. Tinker and Burt (2004) researched about the status of construction courses in construction management programs in the United States and reported that construction programmes should add environmentally related courses to the existing curricula.



Rao et al (2005) also investigated the integration of environmental sustainability into subjects offered at a University in Malaysia. They proffered that a new-approach education system must prepare a student in multi-disciplinary thinking and application to guarantee more sound problem-solving based upon an individual's ability to relate multiple and related issues. Thus, they recommended that the Malaysian Higher institutions need to prepare new professionals who are able to feel comfortable in a multi-disciplinary framework.

Ahn, et al (2009) also investigated the level of construction students' familiarity and interest regarding sustainability in the built environment, their ability to identify recognizable sustainable rating systems and factors affecting students' attitude toward sustainability. They found that construction students perceived to have a relatively high level of familiarity with sustainable construction and Leadership in Energy and Environmental Design (LEED) was the most widely recognised sustainable construction rating system by construction students. They also identified some factors like work experience and courses related to sustainable development would affect students' attitude toward sustainability.

Other researches include Hayles et al (2006) who worked on a case study about how Royal Melbourne Institute of Technology (RMIT) exposed their undergraduate students to the issues of housing sustainability and affordability and changed their curriculum for sustainability. Haselbach and Fiori (2006) explained the importance of developing an appropriate pedagogy, curricula, and accreditation to achieve sustainable construction in the U.S. Graham (2000) undertook research about teaching and learning environmental literacy for the building professions. In addition, Ahn et al (2008) developed an undergraduate sustainable construction course for construction students based on systematic course development theory. Zhang et al. (2008) also developed tools and strategies including a course and a textbook for sustainability integration into civil environmental engineering education.

The sustainability challenges that the human society is grappling with are increasingly urgent as the rates of change in many dimensions are accelerating. Given the urgency for confronting sustainability challenges, opportunities are emerging for different stakeholders who have a significant potential towards providing the knowledge on sustainability to prospective built-environment professionals. Institutions of higher learning are critically important places of knowledge production, knowledge perpetuation and knowledge dissemination. In that context, the university could be, through its teaching and curriculum, promoting and advancing sustainability (Colucci-Gray et al., 2006).

## **MANAGEMENT OF UNIVERSITY EDUCATION IN NIGERIA**

University education in Nigeria is controlled by the Federal Government through the National Universities Commission (NUC), a body charged with the coordination of university management in the country. The NUC was established in 1962 as an advisory agency and in 1974, it became a parastatal under the Federal Ministry of Education. The main functions of NUC are outlined as follows:

1. Granting approval for all academic programmes run in Nigerian universities
2. Granting approval for the establishment of all higher educational institutions offering degree programmes in Nigerian universities
3. Ensure quality assurance of all academic programmes offered in Nigerian universities

#### 4. Channel for all external support to the Nigerian universities

The commission has six departments; Department of Academic Standards, Department of Inspection and Monitoring, Department of Management Support Services, Department of Student Support Services, Department of Research and Innovations and the Executive Secretary's Office. The Academic Standards department is made up of 4 divisions, namely; Planning division, Curriculum Development division, Industrial Collaboration and Facilities and Infrastructural planning and Development.

Some of the Roles of the Curriculum Development division are outlined below;

1. Coordinating the setting of Benchmark Minimum Academic Standards (BMAS) for undergraduate and Postgraduate programmes in all Nigerian Universities
2. Ensuring periodic review of BMAS every five years as well as constantly intimating the universities on new curriculum related policy changes and global trends
3. Conducting periodic Needs Assessment of Nigerian graduates at both local and international markets
4. Advising government on possible need for policy review in relation to any aspect(s) of curricula in university education in Nigeria
5. Organising workshops/seminars on curriculum development for the universities as the need arises
6. Ensuring compliance by universities with the BMAS for the various programmes

Under the Industrial Collaboration division of the Academic Standards department, there is the Professional Bodies section responsible for the following roles;

1. Procuring professional advice or inputs into the development of academic programmes in Nigerian universities
2. Liaising with professional bodies for purposes of harmonising accreditation of degree programmes in Nigerian universities, and also harmonising curriculum review and development.

(Source: National Universities Commission, 2010)

## NEED FOR THE STUDY

Environmental and sustainability issues such as overpopulation, resource depletion, and pollution, which result in rapid decline of the habitability of the earth, highlight that the sustainability issue is urgent, transcends traditional discipline boundaries, and has broad biological, political, organizational, social and cultural implications that affect all elements of society. Thus considering the sustainability challenges that the human society is grappling with, coupled with the identified deficiency in knowledge and practice of sustainable construction on the part of some professionals in Nigeria, there is the need to identify ways of bridging this gap for these professionals to be knowledgeable in this sub-field of construction.

As reported by Shelbourn *et al*, (2006), sustainability goals can only be achieved if construction activities are informed by new resources of knowledge and expertise. Therefore to be on the path towards sustainability in the future and to produce graduates who meet these needs, it becomes imperative to investigate the awareness of the educators and the students on sustainability issues and to study the existing

curriculum of built-environment professions in order to ascertain the adequacy of the training given to the prospective built-environment professionals with respect to sustainability.

## AIM AND OBJECTIVES

This research was aimed at appraising the adequacy of university training with respect to sustainability for prospective built environment professionals with a view to establishing whether sustainable construction issues has been adequately captured. The objectives of this study were to:

1. To conduct a course content analysis of the existing curriculum of built-environment professions for the inclusion of the principles of sustainable construction.
2. To identify the level of familiarity of the built-environment students and educators with the concept of sustainability and sustainable construction.
3. To identify factors that may hinder the extent to which sustainability is captured.

## RESEARCH METHODS

This study was carried out by conducting a detailed content analysis of the curricula of five (5) built environment disciplines (Architecture, Building, Civil Engineering, Quantity Surveying and Urban and Regional planning) in five (5) selected tertiary institutions. The institutions were Ahmadu Bello University, Obafemi Awolowo University, University of Jos, University of Lagos and Covenant University and were selected on the basis that four (4) are the foremost in these professions and one, a new privately owned university. The content analysis was carried out with the aid of a checklist. The curriculum was benchmarked against the checklist which was prepared using extracts on sustainable construction requirements from the following standard documents; (i) *Agenda 21 for Sustainable Construction in Developing countries*; (ii) *Sustainability and the Construction Industry - CIOB* and (iii) *Sustainability: Achieving Excellence in Construction Procurement Guide – Office of the Government Commerce, UK*. Course modules in the curricula, whose outlines had some conformity with the requirements of sustainable construction were identified for each of the degree programmes at each University and presented in tables.

In addition to the content analysis, a questionnaire was also administered to a sample of lecturers, undergraduate and postgraduate students in all of the Departments of the selected institutions. The purpose of this questionnaire survey was to solicit general information on the respondents' knowledge and awareness on sustainable construction so as to get a feel of how importantly the academic environment viewed sustainability. The target audience (respondents) were narrowed down to five final year students, three post-graduate students and two lecturers per department for each of the selected Universities. A total of 210 questionnaires were administered for this study of which 189 were returned with valid responses.

## FINDINGS AND DISCUSSION

### Sustainability coverage in the curriculum of built environment professions

After thoroughly perusing the curricula of the sampled professions in the selected Universities through the use of a checklist, the breakdown of the extent of sustainable construction coverage is summarized in the tables below. The examination of the curriculum of built environment professions in A.B.U, Zaria revealed that the

Departments of Architecture and Building had more coverage of sustainability issues in a higher number of courses as against the Departments of Quantity surveying, Urban and Regional Planning having little or no sustainability representation, Civil Engineering had no coverage at all. The breakdown is presented in Table 1.

Table 1: Sustainability coverage at the Ahmadu Bello University, Zaria

Department	5	4	3	2	1	Course Title
Architecture		√				Arch230:Man-Environment Relations; Arch433: Environmental Science; Arch525 Building Economics I; PDLA521: Fundamentals of Ecology; MUD822: Land Resources Evaluation Techniques; MUD808: Exposition in Environmental Design and Sustainable Environment
Building		√				Bldg501: Building Construction Technology VI; Bldg527: Sustainable Building and Construction; Bldg510: Integrated Services in Building; BLDS 705: Energy Studies; BLDF701: Environmental and Risk Management.
Civil Engineering					√	No Sustainability Coverage
Quantity Surveying				√		QTY511:Cost Control II
Urban and Regional Planning				√		URPL208: Environmental Planning; URPL505: Environmental Impact Assessment

Legend: 5 = Adequately captured; 4 = Captured; 3 = Fairly captured; 2 =Inadequately captured; 1 =Not captured.

Out of the total of 45 courses offered in the undergraduate programmes in Architecture, only two of the courses has sustainability related content, i.e. Arch 230: Man-environment relations and Arch 433: Environmental Science. Out of a total 67 courses offered at the postgraduate level for Master of Science in Architecture, Post Graduate diploma in landscape Architecture, Master of Landscape Architecture and Master of Urban Design, four of the courses contained sustainability issues. They are Arc 525: Building Economics I, Arc 521: Fundamentals of Ecology, MUD 822: Land Resources Evaluation Techniques and MUD 808: Exposition in Environmental Design and Sustainable Environment.

The Department of Building offers seventy courses at undergraduate level, of which only three contain some sustainability issues. They are Bldg 501: Building construction technology, Bldg 510: Integrated services in building and Bldg 527: Sustainable Building and Construction. The Department also offers 37 courses for the postgraduate programmes of MSc Construction Management, MSc Construction Technology and Master of Facility Management. Only BLDS 705: Energy Studies and BLDF 701: Environmental and Risk Assessment have sustainability content.

The Department of Quantity Surveying offers 67 courses in the undergraduate programme but only QTY5 11: Cost Control was relevant. The Department of Urban

and Regional Planning offers a total of 47 courses out of which 2 courses have some sustainability components. These are URPL 208: Environmental Planning and URPL 505: Environmental Impact Assessment. There is no sustainability coverage in all 72 courses offered in the department of Civil Engineering.

At University of Jos, the Department of Architecture had more sustainability content as against the Departments of Building and Urban and Regional Planning. Civil Engineering and Quantity Surveying are not offered. A total of 62 courses are offered in Department of Architecture of which Arc 112: Planning the Built Environment, Arc 411: Introduction to Cost Control and Appreciation and Arc 515: Landscape Design. Of 86 courses are offered at undergraduate level in Building Department, only BUD 452: Construction Economics; and BUD 561: Development of New Building Materials has related content. Urban and Regional Planning offers 60 courses out of which two has sustainability related issues. A breakdown is presented in Table 2.

Table 2: Sustainability coverage at the University of Jos, Jos

Department	5	4	3	2	1	Course Title
Architecture			√			ARC 112: Planning the Built environment; ARC 411: Introduction to Cost control and appreciation; ARC 515: Landscape Design
Building				√		BUD 452: Construction Economics; BUD 561: Development of new building materials.
Civil Engineering						Course Not Available
Quantity Surveying						Course Not Available
Urban and Regional Planning				√		GEO 221: Natural environmental systems and processes; GEO 461: Environmental and resource management

Legend: 5 =Adequately captured; 4 =Captured; 3 =Fairly captured; 2 =Inadequately captured; 1 =Not captured

At the University of Lagos, Urban and Regional Planning Department had more coverage of sustainability in a higher number of courses as against the Departments of Architecture and Building, while the Department of Quantity surveying had the least coverage. A total of 64 undergraduate and 20 postgraduate courses are offered at the Department of Architecture of which only Arc 342: Environmental Planning (undergraduate) and Arc 515: Landscape Design is relevant. The Building Department has BLD 513: Development of New Building Materials and BLD 534: Energy Utilisation in Building having sustainability content. In the Civil Engineering Department, two out of 68 courses offered contained sustainability issues with Urban and Regional Planning having two of the total of 82 courses offered in the undergraduate programme have sustainability related issues i.e URP 204: Natural Resources Management and Environmental Planning and URP 421: Environmental Impact Assessment Practice. Only one of the 28 courses offered in the post graduate programme has related content on sustainability. (Refer to Table 3).

Table 3: Sustainability coverage at the University of Lagos, Lagos

Department	5	4	3	2	1	Course Title
Architecture				√		ARC 342: Environmental planning; ARC 644: Environmental Impact Assessment;
Building				√		BLD 513: Development of New Building Materials; BLD 534: Energy Utilisation in Building
Civil Engineering				√		CEG508:Environmental Engineering III; CEG 532; Environmental Engineering IV
Quantity Surveying					√	No Sustainability Coverage
Urban and Regional Planning			√			URP204: Natural Resources Management and Environmental Planning; URP 421: Environmental Impact Assessment Techniques URP822: Environmental Impact In Urban and Regional Planning.

Legend: 5 =Adequately captured; 4 =Captured; 3 =Fairly captured; 2 =Inadequately captured; 1 =Not captured

At the Obafemi Awolowo University, Ife (O.A.U), the Departments of Architecture and Building both had more coverage of sustainability issues than the Departments of Quantity surveying, and Urban and Regional Planning, while the Department of Civil Engineering had the least coverage. Three of the total of 62 courses are offered at undergraduate level in Architecture have related content. These are Arc 321: Environmental Sciences, Arc 402: Environmental Impact Assessment and Arc 408 Environmental Planning. In the Building Department, three out of 72 courses offered have sustainability related issues i.e. BLD 302: Environmental Planning and Resource Management, BLD 402: Construction Economics and Cost Control and BLD 524: Fundamentals of Ecology. In the Department of Quantity Surveying, only QTY 321: Cost Control was relevant to sustainability, while in Urban and Regional Planning Department, two of the total 70 courses offered have related content. These are URP 301: Natural environmental Systems and Processes and URP 505: Environmental Impact Assessment. (Refer to Table 4)

At Covenant University, which is a new privately owned University, sustainability issues were inadequately captured in the curriculum of the Departments of Architecture, Building and Civil Engineering. The professions of Quantity Surveying and Urban and Regional Planning are not offered at the University. Of the total of 76 courses are offered in the undergraduate programme in Architecture, and only Arc 229: Environmental Sciences has related content, similar to the Building and Civil Engineering Departments where one of 53 and 75 courses offered respectively has related content i.e. BLD 516 Building Materials Development and CVE 511: Environmental Engineering. (Refer to Table 5).

Table 4: Sustainability coverage at the Obafemi Awolowo University, Ile-Ife

Department	5	4	3	2	1	Course Title
Architecture			√			ARC 321: Environmental Sciences; ARC 402: Environmental Impact Assessment; ARC 408: Environmental Planning
Building			√			BLD 524: Fundamentals of Ecology BLD 302: Environmental Planning and Resource management; BLD 402: Construction Economics and Cost control
Civil Engineering					√	No Sustainability Coverage
Quantity Surveying				√		QTY 321: Cost Control
Urban and Regional Planning				√		URP 301: Natural Environmental Systems and Processes; URP 505: Environmental Impact Assessment
Legend: 5 =Adequately captured; 4 =Captured; 3 =Fairly captured; 2 =Inadequately captured; 1 =Not captured						

Table 5: Sustainability coverage at the Covenant University, Otta

Department	5	4	3	2	1	Course Title
Architecture				√		ARC 229: Environmental Sciences;
Building				√		BLD 516: Building Materials Development.
Civil Engineering				√		CVE511:Environmental Engineering;
Quantity Surveying						Course Not Available
Urban and Regional Planning						Course Not Available
Legend: 5 =Adequately captured; 4 =Captured; 3 =Fairly captured; 2 =Inadequately captured; 1 =Not captured						

A summary of the ratings of the courses at the different Universities is presented in Figure 1 which clearly shows that none of the Departments had the highest rating of 'adequately captured'. Only two Departments had a higher rating of 'captured', followed by four Departments having the next rating of 'fairly captured'. Twelve of the twenty five sampled Departments had the rating of 'little captured'. This clearly indicates that almost half of the sampled Departments had little coverage of sustainability in its curriculum. It was also observed that three (3) departments had the least rating of 'not captured'.

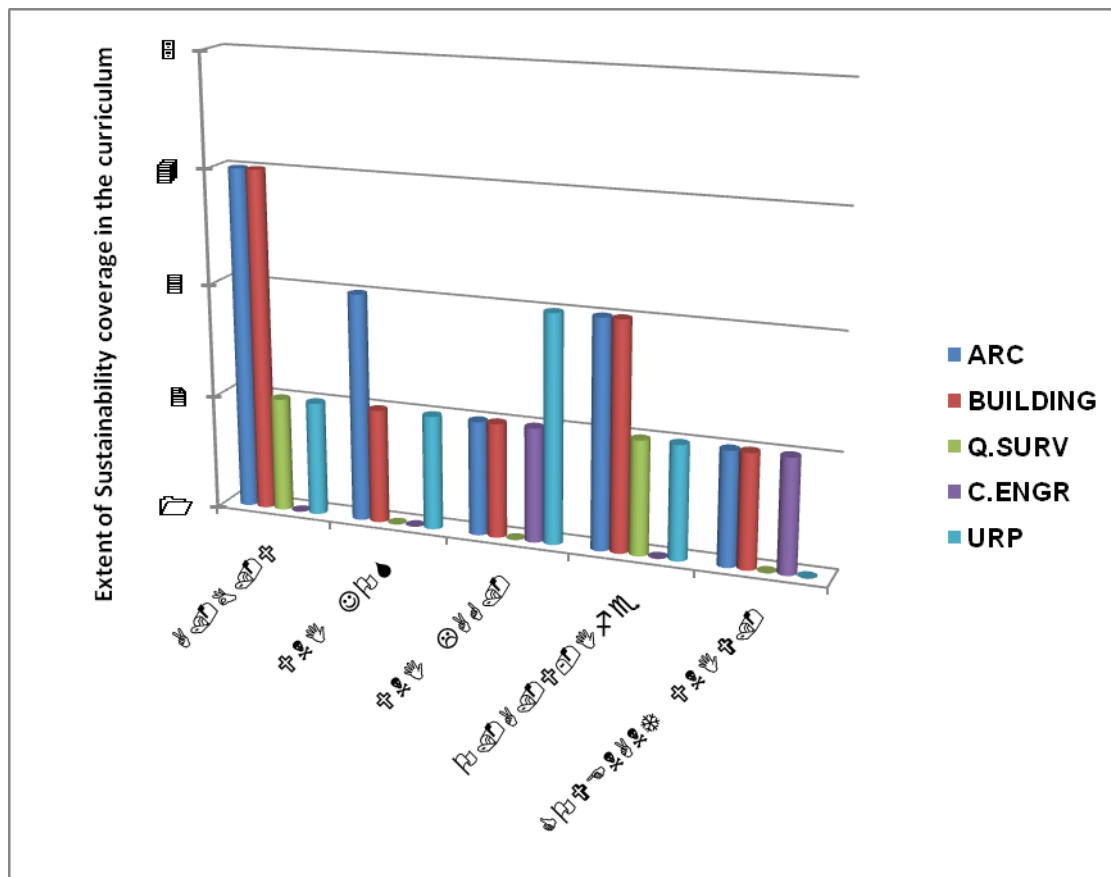


Figure 1: Extent of sustainability coverage in the curriculum of the built environment professions

### Sustainability awareness of students and educators

Of the 210 questionnaires administered, 189 were returned with valid responses. This shows a response rate of approximately 90%. A breakdown of this response rate shows that the undergraduate students have the highest of 100% responding, followed by postgraduate students with 86%, while the lecturers have a response rate of 71%. The detailed information regarding the sample size and the response rate according to status/year of study in the university is summarized in Table 6.

Table 6: Research sample and response rate according to university status

	Undergraduate students		Post-graduate students		Lecturers		Total	
	No.	%	No.	%	No.	%	No.	%
Sample	105	100	63	100	42	100	210	100
Response	105	100	54	86	30	71	189	90

### Familiarity with sustainable construction

Familiarity with sustainable construction was determined by assessing the respondents' awareness on three major questions and some sub-questions such as the identification of the most suitable definition of sustainable construction from a given list of options, identification of the three key issues/aspects of sustainability and the identification of the widely used sustainability assessment tools in the construction industry.



The research showed that approximately 49% of the respondents were able to identify the most suitable definition of sustainable construction from the list of options given. It was also observed that 52 % of the respondents correctly identified the three key components of sustainability while only 35 % of the respondents were able to identify different types of sustainability assessment tools in use in the construction industry. The summary of these responses are presented in Table 7.

Table 7: Awareness on sustainable construction issues

Most suitable definition of sustainable construction			The 3 key issues of sustainability			Identification of sustainability assessment tools			
Option	Freq.	%	Issues	Freq.	%	BREEAM, LEED, Life-cycle Analysis, Eco-efficiency, Social Auditing and Reporting, Environmental Management Systems, etc.	Option	Freq.	%
1	23	12	Environmental, Social and Political	25	13		A	26	14
2	92	49	Economic, Environmental and Social	98	52		B	66	35
3	61	32	Environmental, Economic and Cultural	51	27		C	74	39
4	13	7	Economic, Political and Cultural	15	8		D	23	12

**Legend:** 1= A construction process that is economically viable and can be sustained overtime resulting in business growth and profitability for the organisation. 2=The use of environmentally friendly materials, energy efficiency in buildings and management of construction waste with the aim of restoring harmony between the natural and the built-environment and the well-being of end users

3= Sustainable construction comprises many processes through which a construction firm delivers built assets to enhance quality of life and stakeholder satisfaction. 4= A construction process that ensures adequate and affordable housing for everyone in the society.

A= Project Performance Tools; B= Sustainability Assessment Tools; C= Ecological Management Tools; D= Organisational management Tools

Likert-type scaled questions revealed that a fairly high percentage of the respondents (58.2%) agree that construction significantly contributes to waste, energy consumption, environmental pollution and greenhouse gas emission. Approximately fifty three percent agree that facilities should be designed to minimise energy use and reduce pollution. Fifty five per cent also agreed that the waste generated by the construction industry can be minimised through the adoption of the concepts of recycling, re-use and reduce, while 57.1% of the respondents strongly agree that students should have an understanding of the impact construction has on the environment and should be taught about the concept of sustainability in construction. The summary of these findings are presented in Table 8.

Table 8: Respondents' view on some sustainability related issues

Sustainability related issues	Responses (%)				
	1	2	3	4	5
Construction activities significantly contribute to waste, energy consumption, environmental pollution and greenhouse gas emissions.	0.0	0.0	13.8	58.2	28.0
Facilities should be designed within the context of functionality to minimise energy use and reduce pollution	0.0	0.0	12.2	52.9	34.9
Amount of waste generated by the construction industry can be minimised through adopting the concepts of recycling, re-use and reduce	0.0	0.0	9.0	55.0	36.0
Students should have an understanding of the impact construction has on the environment and should taught about the concept of sustainability in construction	0.0	0.0	4.8	38.1	57.1

Legend: 1=Strongly disagree, 2=Disagree, 3=Undecided, 4=Agree, 5=Strongly agree

Furthermore, the study sought their opinion on the degree of importance of some project goals on a scale of 1 – 4 and the Relative Importance Index (RII) was computed for each factor. It was observed that cost and quality were considered most important with an RII of 3.81 and 3.76 respectively followed by timely project delivery and prudent use of resources (3.61). Protection of the environment and health and safety goals were considered least important with RIIs of 3.35 and 3.24. This indicates that the last three factors which are largely core sustainability issues were not considered as important as the factors of cost, quality and time. The breakdown is contained in Table 9.

Table 9: Level of importance of project goals

Factors	Responses (%)				
	1	2	3	4	RII
Building to minimal cost	0.0	0.0	18.9	81.1	3.81
Building to high quality	0.0	0.0	23.8	76.2	3.76
Timely project delivery	0.0	0.0	39.0	61.0	3.61
Prudent use of natural resources	0.0	0.0	39.3	60.7	3.61
Effective protection of the environment	0.0	6.0	52.8	41.2	3.35
Health, safety and conducive working environment	0.0	10.3	55.3	34.4	3.24

Legend: 1= Indifferent, 2=Not important, 3=Important, 4=Very important, RII =Relative Importance Index

### Factors hindering the incorporation of sustainability into the curricula

Several factors adopted from the works of Covich (2008) and Bekessy et al (2009), were included in the questionnaire (for the educators only) to establish possible reasons hindering the incorporation of sustainability. They were ranked on a scale of 1-4 in the opinion of the respondents and the results are shown in Table 10.

The result of the respondents indicated that the most important factor militating against the incorporation of sustainability into the curriculum was the lack of adequate knowledge and awareness of the concept of sustainable construction. This was followed by the other factors as ranked in Table 10. These results suggest that an

important first step to introducing the concepts of sustainability into the curriculum is to have an understanding of the concept in a holistic manner. This will in turn help in identifying sustainability issues relevant to course subject matter. In addition, there is the need to provide educators with models, case studies and experiences so that they could incorporate sustainability into the courses in the curriculum. This will require integration in the form of seminars and workshops between the academic institutions and relevant professional/regulatory bodies in creating awareness on sustainability.

Table 10: Factors hindering incorporation of sustainability in the curriculum

Factors	Mean	Standard Deviation	Rank
Lack of adequate knowledge and awareness of the concept of sustainable construction.	3.95	0.72	1
Different perspectives about sustainability	3.81	0.98	2
Problem of identifying sustainability issues relevant to course subject matter.	3.48	1.08	3
Lack of appropriately trained educators on sustainability issues in a holistic manner.	3.42	1.18	4
Lack of integration between the academic institutions and relevant professional/regulatory bodies in creating awareness on sustainable construction.	3.30	1.22	5
Lack of interest on the part of relevant bodies responsible course accreditation	3.04	1.27	6

Legend: 1=No impact; 2=Minor impact; 3=Moderate impact; 4=High impact;

## CONCLUSIONS AND RECOMMENDATIONS

The following conclusions were made from the research work;

- This study showed that there are significant gaps in the current University education and professional training with respect to sustainable construction as sustainability has not been explicitly considered in existing curricula.
- Familiarity with sustainability is quite low among the respondents particularly their understanding of the concept, key issues/aspects and sustainability assessment tools widely used in the construction industry.
- The educators opined that the most significant factor which may hinder the incorporation of sustainability into the curriculum was a “lack of adequate knowledge and awareness of the concept of sustainable construction”.

The following recommendations are made:

- As there are significant deficiencies in the course content regarding sustainability, the minimum standard curricula and training programmes need to be revisited by the NUC and the allied professional bodies to reflect the centrality of sustainability requirements in the creation of the built environment.
- As the NUC only specify the minimum benchmark for degree programmes in Nigeria, the individual Universities should work towards enriching the curriculum on their own accord
- Workshops, conferences and other training functions can be developed to sensitize and motivate the academia in general (both students and educators).

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# THE APPLICABILITY OF THE HARVARD AND WARWICK MODELS IN THE DEVELOPMENT OF HUMAN RESOURCE MANAGEMENT POLICIES OF LARGE CONSTRUCTION COMPANIES IN GHANA

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Organizations develop and implement Human Resource Management (HRM) policies which are a reflection of their philosophy on how they intend to manage people. The factors outlined in existing HRM models, especially the Harvard and Warwick models, as influencing HRM policy development and practice, fall within the political, economical, social, technological, environmental and legal domains as well as what the Harvard model describes as organizational situational domain. These models were however developed in the North American and European contexts. The question arises as to whether these models hold true in the context of developing countries. A cross-sectional survey was conducted in Ghana to identify the factors which influence the development of HRM policies of large construction organizations operating within the Ghanaian Construction Industry. The data was analyzed using narrative and thematic analysis techniques. The results indicated that, the factors identified by respondents can be regrouped under the domains identified in the existing HRM models, suggesting that the factors to consider in the development of HRM policies in the North American and European context do hold true for the Ghanaian construction industry. However, further research is recommended to validate the factors identified in this study.

Keywords: developing country, Ghana, human resource management, human resource management model, policy development.

## INTRODUCTION

Though HRM sometimes seems to have popped out of the blues in the 1980's and 1990's as an entirely different approach (Armstrong, 2003), it is actually a part of the evolution of concept of managing people in organizations, with HRM being just the 'latest stage of this evolution' (Grant and Oswick, 1998). It can be described "... as old wine in a new wine skin" (Armstrong, 1987). In the words of Torrington (1989), "Personnel Management has grown through assimilating a number of additional emphases to produce an even richer combination of experience... HRM is no revolution but a further dimension to a multi-faceted role". The concept has evolved from the Industrial Relations era, through Personnel Management to HRM and more

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recently, strategic HRM which involves strategically integrating the HRM function, horizontally and vertically, into the organization.

Conceptual model developments began in the 1980s with the first christened as the Matching or Michigan Model (1984), followed by the Harvard Model that same year. These two models are regarded as the basis of future HRM models, which include the best practice (outcomes) and the contingency (strategic fit) model (Hope-Hailey et al., 1998). Contributions by English authors include Guest (1989a; 1989b; 1991; 1987); Legge (1989); Hendry and Pettigrew (1990); Purcell (1993); Sisson (1990); and Storey (1989).

This paper presents an assessment of the factors that influence the development of HRM policies within large construction companies in Ghana and seeks to determine if factors that affect HRM policy development in the North American and European context do hold true for the Ghanaian context. The Harvard and Warwick models will be examined. These have been selected due the provisions they make, to allow for a good comparison of the factors proposed by these models, and what was found from a survey of construction companies operating in Ghana.

## BACKGROUND

### The Harvard Model

Also described as the ‘founding fathers’ of the HRM concept were Beer et al (1984) who’s model Boxall (1992) dubbed the ‘Harvard Framework’ (Figure 1). Beer et al (1984) believed that, many pressures are demanding a broader, more comprehensive and more strategic perspective with regard to the organization’s human resources’ which have created a need for ‘longer-term’ perspective in managing people and consideration of people as potential assets rather than merely a variable cost. According to Armstrong (2003), the framework is based on the belief that, the problems of historical personnel management can only be solved when general managers develop a viewpoint of how they wish to see employees involved in and developed by the enterprise, and of what HRM policies and practices may achieve these goals. Without either a central philosophy or a strategic vision – which can be provided only by general managers, he added that, HRM is likely to remain a set of independent activities, each guided by its own practice tradition.

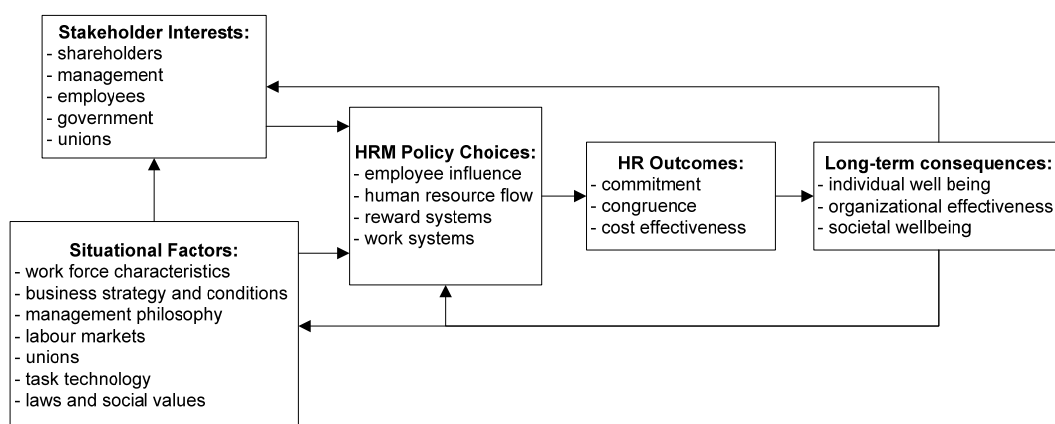


Figure 1 The Harvard Framework (Beer et al., 1984)



Beer et al (1984) stressed on the role of line managers who in their view, should accept more responsibility for ensuring the ‘alignment of competitive strategy and personnel policies’; and secondly ‘have the mission of setting policies that govern how personnel activities are developed and implemented in mutually enforcing ways’. Huczynski and Buchanan (2001) and Loosemore et al (2003) added that, the Harvard Model provided the needed link between “SHRM decisions, the business environment and an organization’s performance”. It provided a more open system model of how SHRM policy influences other organizational functions and is constrained by stakeholders and situational factors. According to Boxall (1992) and recorded in Armstrong (2003), advantages of the model include the under listed:

- It incorporates recognition of a range of stakeholder interests;
- It recognizes the importance of ‘trade-offs’, either explicitly or implicitly between the interests of owners and those of employees as well as between various interest groups;
- It widens the context of HRM to include ‘employee influence’, the organization of work and the associated question of supervisory style;
- It acknowledges a broad range of contextual influences on management’s choice of strategy, suggesting a meshing of both product-market and socio-cultural logics;
- It emphasizes choice – it is not driven by situational or environmental determinism.

Walton (1985) expanded on this model by stressing on the importance of mutuality. In his words, “the new HRM model is composed of policies that promote mutuality – mutual goals, mutual influence, mutual respect, mutual rewards, and mutual responsibility”. He added that, policies of mutuality will elicit commitment which in turn will yield both better economic performance and greater human development.

The Harvard Framework has not been without shortfalls. Loosemore (2003) pointed out that, “although it acknowledges environmental and stakeholder influences, the nature of the causal chain suggested by the model is unclear”. It explained this by stating that, the framework does not explain how the four policy areas are influenced by the identified environmental and stakeholder influences and how it does in the long term affect SHRM. This framework, to a large extent however, informed future developments of the concept.

### **The Warwick Model**

One of the major setbacks in the conceptual developments of the HRM concept up to this time was that most of the earlier developments were within an American Context. Approaches outside of this context required a perspective of the particular cultural context that exists in different countries. The Warwick Model, which emanated from the Centre for Corporate Studies and Change at the University of Warwick by Hendry and Pettigrew (1990) differs from the Harvard models by reflecting European traditions and management styles. The model (Figure 2) basically comprise five interrelated elements which allows an analysis of how external factors impact upon the internal operations of the organization reflecting the open system theory of organizational thinking.

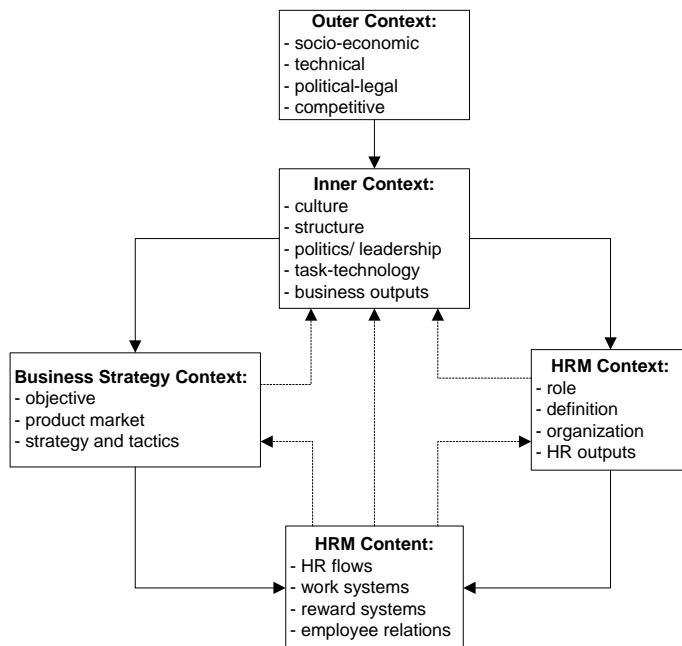


Figure 2 The Warwick Model (Hendry and Pettigrew, 1990)

Organizations in this case achieve an alignment between the external and internal context to experience higher performance. The model recognizes the wider context in which HRM operates and emphasizes the full range of tasks and skills that define HRM as a strategic function (Loosemore et al., 2003). Hendry and Pettigrew (1990) argue that, better descriptions of structures and strategy making in complex organizations, and of frameworks for understanding them, are essential underpinnings for HRM. In Armstrong (2003)'s view, Hendry and Pettigrew (1990) believe that as a movement, HRM expressed a mission, to achieve a turnaround in industry: HRM was in a real sense heavily normative from the outset: it provided a diagnosis and proposed solutions. Hendry and Pettigrew (1990) further added that, what HRM did at this point was to provide a label to wrap around some of the observable changes, while providing a focus for challenging deficiencies – in attitudes, scope, coherence, and direction – of existing personnel management.

It is based on this theoretical framework that this comparison will be based. It will basically consider the factors these two models identified as affecting HRM (Figures 1 and 2) and compare them with what responses were obtained from the survey.

## METHOD

Data draws on the results of a survey comprising questionnaires and semi-structured interviews which forms part of a larger research being conducted at the Kwame Nkrumah University of Science and Technology, aimed at investigating the HRM practices and policies of large construction companies. The questionnaire investigates characteristics of these companies, the nature of their HR function, and the characteristics and provisions of their HRM policies. The semi-structured interview sought to investigate into greater detail the HRM policies and practices of these companies with emphasis on how their HRM activities are executed.

Company selection was based on the large construction companies (D1/K1) 2005 registry of the ABCECG. Forty-nine construction companies were registered hence adopted as the population for the survey. Stratified and random sampling methods

were adopted with the regional division of the country, ten in number, used as the strata criteria. Using ratios, the strata sample sizes was determined and companies selected randomly within the strata. Thirty-six companies responded to the self-administered questionnaires with twenty-eight taking part in the face-to-face interview. Data obtained from the questionnaires was analysed using descriptive analysis techniques while thematic and narrative analysis was used for the semi-structured interviews. These methods were selected due to the focus of the instruments which required that the content of the data be analysed qualitatively to identify key themes, trends, concepts, categories and methods.

Companies were thus divided into three groups based on their origin as commonalities were found along these lines. The classifications were local companies, foreign companies and a Joint Venture.

## HEM POLICY DEVELOPMENT IN LARGE CONSTRUCTION COMPANIES

Respondents in the survey noted that, the factors listed in Table 1 below, influences the development of HRM policies.

Table 1: Factors influencing the development of HRM policies

Local Companies	Foreign Companies	Joint Venture
1. Educational level of employees	1. Educational level of employees	1. Educational level of employees
2. Nature of industry	2. No guidelines to aid in incorporating local	2. Environmental influences
3. Structure of firms	conditions in their policies	3. Religious influences
4. Technological development	3. Nature of employment	4. Ethnic origin of employees
5. Economic influences	3. Availability of resources	5. Economic influences
6. Political influences		6. National policies

The educational background of employees is a major factor that influences policy development. The justification respondents gave included the fact that, due to the low educational level of employees, they are not concerned about some provisions which in the organizations view will be very beneficial to them like the payment of social security contributions and even in some cases, taxes.

*“The majority of our workforce comprises artisans and labourers. I must say they form more than 80% of the total employee base. Now, if these people have so little education, which is usually the case, they do not appreciate you putting in measures to ensure they are managed properly, such as paying social security contributions and taxes, organizing training workshops for them, insisting they use safety garments and equipments etc. They tend not to appreciate everything you do for them. How can one help them in anyway not forgetting that we work with very limited resources? Their focus is on cash cash cash and so we give them the cash and rest our case!” (C21-LC-I)*

Also was the fact that, even when explicit policies are provided, their educational level makes it difficult if not impossible for the employees to read hence the need for implicit policies or putting in place appropriate communication structures within the company to ensure policies are appropriately communicated to all employees effectively and appropriately.

One other issue that was raised by the local companies is the nature of the industry. This in their view will influence policy development due to the peculiar characteristics of the industry which requires that a transient workforce is employed with a lesser number of permanent employees. This they said will require that HRM policies are reviewed regularly to suit these transient employees.

*“Our industry is very peculiar so some processes which work in other stable industries do not apply to us. On the issue of even employing an HRM practitioner, these people do not understand the needs of our industry and they can frustrate us by making uncomplicated issues very complicated. So I manage my own company, manage my own people and determine my own policies.” (C21-LC-I)*

Also was the concern of making either project based policies or company policies. This was perceived as a concern because of the ethnic divisions of the country which have various traditions, cultures and norms. Hence a policy of the company; example a policy that employees will work five days during each working week and rest on weekends, may not hold in communities that have say a Tuesday as their resting day. Also, some communities have expectations when infrastructure is being developed in their area such as employment of a certain number of their youth, performance of certain rights, and taboos that the company will have to comply with and might be against some existing policies.

*“The project based nature of the industry will require that we develop policies for individual projects. Now each project has its own characteristics: location, size, complexity amongst others, and all these will affect HR issues such as labour market characteristics, expectations and the likes. Things really do get complicated hence takes a lot of planning and consumes time.” (C13-LC-I)*

Also was the issue of religion. Controversies included the fact that, Muslims go to the mosque on Fridays and have to pray during working hours, some Christians observe the Sabbath on Saturdays whereas other sects do so on Sundays. Also is the existence of the Ghanaian traditional religion. Satisfying these differences will require that, HRM policies take these characteristics into consideration.

The existing structure of companies and technological developments are also factors that respondents suggested will influence policy development. The structure of the company they said should be considered because that will determine and show how the company is managed as well as the roles and responsibilities of personnel. This they said will inform policy makers in designing say the reward structure of the company as well as determining the level of employee involvement in decision making, decentralization of companies amongst others. Technological developments they added will influence policy development in that, it will influence the organizational structure, hence which employees to be employed and how they should be managed.

*“The organogram of the organization influences policy development in that, if there is a change in the organogram, caused by technological developments, the economy, a change in the capital base of the company or any other reason, we have to review our policies, determine new roles, adjust methods of communication amongst a whole lot of other issues,” (C36-FC-I)*

Another very interesting factor mentioned is economic factors. This can be looked at in two phases: the economy of the country; and the economic condition of the company. The national economy will indicate how much premium the government allocates to infrastructural development as well as general economic comfort and structures which will enable private clients to invest in infrastructure. This they said will to a large extent contribute to the growth of the industry and provide them with the stability, the ability to maintain their employees resulting in job security for employees hence can make long term plans and policies.

*“Though we have some private clients, majority of the contracts that are worth fighting for are government contracts. These are actually what ginger our development and growth as an industry. So what we need is a government economic focus on the need for more infrastructural development in the country.” (C15-LC-I)*

The economic condition of the company can be looked at as the availability of resources: capital, materials, labour, plant and equipment to be able to execute projects. The availability of resources they said will avoid breaks in project execution which will ensure they complete projects on time and do not have to deploy their staff which will disturb their sense of security. Availability of capital, respondents noted, will aid in providing some contingencies and financial rewards for employees. It will also help to meet the training and development expectations of employees which in the long run will see to the development of the organization.

The JV Company noted that the origin of employees is a factor. They noted that, employees from different parts of the country have peculiar traits which influence their attitude to work as well as to life in general. This they said requires that certain policies are developed to take care of the needs of this variant workforce.

*“The ability to know and understand where employees originate from helps in satisfying some needs and expectations which contributes to creating a cordial and satisfactory working environment.” (C36-JV-I)*

Government policies and legislation, such as, the Labour Act, Workmen’s Compensation Law and even the Constitution of the country, were seen as a factor which influences HRM policy development within companies. It was noted that, since these are legal issues, they do not have an option than to ensure they adhere to them and this influences, and even in some cases, determines what policy to develop. Further, they added that, the existence of these laws aids in the identification of the expectations of the various stakeholders which also contributes to maintain a cordial working environment.

*“We operate in a country hence have to know and adhere to its laws concerning what we are involved in. With HRM policies, there are laws like the Labour Act and the Workmen Compensation which we cannot go against. So what ever policy we develop has to be in concordance to provisions in these legislations.” (C30-FC-I)*

*“In all our dealing, including HRM, we cannot go against legislations such as the constitution, the labour act, workmen compensation and even the CA. So I would say we are bound by these and they determine our policies, procedures and practices especially on the issue of HRM.” (C32-FC-I)*

Respondents noted that, these factors including the non-existence of adequately trained HRM personnel to execute this function and even see to policy development

does influence how they manage their people hence what policies they have in place. Some of the foreign companies who have existing policies but wish to review them to suit the local conditions stated that, the lack of guidelines to aid in incorporating local conditions into their policies does affect them in these reviews.

Additional factors identified included: the culture, values, traditions and norms of the organization; government directives, regulations and the likes; the CBA and CoS of organizations; community traditions; circulars, directives and decisions of the BoD; legislation such as the Constitution and the Labour Act; as well as environmental related issues. Also were employee personal demographics - age, gender, ethnic origin, education, marital statues etc.; and some work related demographics - employment status and agreement as well as role in organization; and the view of all stakeholders and social partners concerned.

## THE COMPARISON

HRM policies cannot be developed in a vacuum. They are developed based on certain influencing factors which will need to be considered during the development process. Factors to be considered include those that have an influence on the development process as well as on the policies which will be developed. The factors respondents in the sampled large construction companies identified included: the educational level of employees; nature of the industry; structure of companies; technological development; availability of resources; and the ethnic origin of employees; as well as the nature of employment within the industry. Additional factors were: economic influences; political influences; national policies; environmental influences; and religion.

Table 2: The comparison

Organizational Situational Factors	Data from survey
workforce characteristics	employee personal demographics; educational level of employees; religious influences; culture; ethnic origin of employees
the business strategy and conditions	nature of industry
management philosophy	values, traditions and norms of the organization
labour markets	availability of resources
unions	work related demographics
task technology	technological developments and challenges
laws	nature of employment; regulations: the CBA and COS of organizations
social values	community traditions
External Influencing Factors	Data from survey
political	political influences; government directives
economic	economic influences
social	educational level of employees; religious influences; culture; ethnic origin of employees
technological	technological development
environmental	structure of firms; no guidelines to aid in incorporating local conditions in their policies; environmental influences
legal	national policies; constitution; labour act

These factors can be classified under the stakeholder interests and the organizational situational factors identified in the Harvard HRM model and in the Warwick model's external influencing factors of organizations and their management processes.

The external influencing factors, which were the main contribution of the Warwick model, categorized into six broad terms: political; economic; social; technological; environmental; and legal issues. From the discussions in the previous section and in Table 1, it is evident that the factors that respondents identified as those affecting HRM policy development include all of these factors as identified in Table 2 at the end of this section.

The organizational situational factors of the Harvard model: workforce characteristics; the business strategy and conditions; management philosophy; labour markets; unions; task technology and laws and social values. These factors again were identified in the survey as affecting the development of HRM policies in the Ghanaian context.

## CONCLUSIONS

It can thus be concluded that, the factors that affect the development of HRM policies in of themselves are no respecters of the part of the world one finds them. It can be clearly said from the empirical evidence presented that, the organizational situational factors identified by the Harvard model (Beer et al, 1984) as accounted for by Boxall (1992) to include workforce characteristics; the business strategy and conditions; management philosophy; labour markets; unions; task technology and laws and social values, affect the development of HRM policies in large construction companies operating in Ghana. Also that the external influencing factors identified by the Warwick Model (Hendry and Pettigrew, 1990) which can be classified into six broad themes: political; economic; social; technological; environmental; and legal issues, affect the development of HRM policies in large construction companies operating in Ghana. Further research is however recommended to validate the findings reported as well as expanding the scope to investigate the case across various industrial sectors.

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# THE CONTINUOUS USE OF ASBESTOS IN GHANA DESPITE ITS HAZARDS (CASE STUDY AREA: SEKONDI-TAKORADI)

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This paper report on a research work conducted with the aims of investigating the regulatory position regarding the use of asbestos and also to assess the evidence of the continuous use of Asbestos cement products in the construction industries in Ghana, using Sekondi-Takoradi as a case study area. This paper adopted both quantitative and qualitative research approach to seek information from, landlords, manufacturers of asbestos cement products, parliament and other Government Agencies. Data was obtained through questionnaire, interview and field work survey. In all, a total of 20 questionnaires were distributed. The research emerged that about 1200 housing units roofed with asbestos cement roofing sheet were constructed by the State owned construction company between 1976 and 2000 in the Sekondi-Takoradi Metropolis (about 12000 nationwide), a period when the risk of asbestos was known in Ghana. The study in the newly developing areas in the Sekondi-Takoradi Metropolis indicated that, out of every 100 housing unit being built, at least 40 of these were roofed with asbestos cement corrugated roofing sheet. It also emerged from this research that there were no laws prohibiting the use, manufacturing or importation of asbestos products in Ghana. And this exposes maintenance workers in the building construction industries to the risk of asbestos related diseases. The research recommends that those who have asbestos materials present in their premises should take action to manage the risk so that no one will unknowingly disturb it and also provide information about the material to those who are likely to disturb it.

Keywords: asbestos fibre, housing unit, Ghana, roofing sheet.

## INTRODUCTION

This paper reports on a research conducted with the main aims of investigating into the regulatory position regarding the use and manufacturing of asbestos cements products in Ghana. Investigation into the continuous use of asbestos cement products in Ghana using Sekondi Takoradi as case study area is also reported in this paper. In this study awareness is created on the health risk associated with the use of asbestos cement products with landlords and various decisions making bodies including parliament being the target groups.

## WHAT IS ASBESTOS?

Asbestos is a naturally occurring fibrous material and has been used for about 150 years on a large scale. It is versatile, plentiful and ideal as a fire-proofing and insulation material. According to Sunderson, (2007) there are three main types of asbestos that have been used commercially. These are Crocidolite (blue) Amosite

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(brown) and Chrysotile (white). Sunderson, (2007) and Ridley and Channing (2001) agreed that all the three types are dangerous, but blue and brown asbestos are known to be more dangerous than the white.

## **PHYSICAL PROPERTIES OF ASBESTOS**

Asbestos is a strong, durable, non-combustible fibre. These physical properties make it ideal as a reinforcing agent in cement, vinyl and other building materials. Examples of these are Vinyl floor tiles, bath panels, cold water cisterns, roof felts, corrugated or flat roof sheets, cladding sheets, soffit strips, gutters, and it's ideal for fire proofing and insulation.

Its ability to resist high temperatures, made it so useful in the past. Asbestos is ideal for any process involving the conservation or preservation of heat. The fibre gives protection against fire, corrosion, cold, acids, alkalis, electricity, noise, energy loss, vibration, salt water, frost, dust and vermin (Ridley and Channing, 2001).

Asbestos has been used extensively in the past and may be found in many forms in existing buildings including industrial wall and roof linings, internal partitions, duct and pipe covers, suspended ceilings, fire doors and soffits to porch and canopy linings. It also occurs in plant rooms and boiler houses and as asbestos coatings and insulating lagging on structures and pipe work (Ridley and Channing, 2001).

## **DISEASE ASSOCIATED WITH ASBESTOS FIBRES**

If disturbed, asbestos material may release asbestos fibres which when inhaled into the lungs and accumulated, several diseases may occur. According to HSE (Health and Safety Executives) report, there are four main diseases associated with inhalation of asbestos fibres. These are asbestosis (a scarring of the lung tissue caused by asbestos), two kinds of cancer (mesothelioma and asbestos related lung cancer), and diffuse pleural thickening (a non-malignant disease affecting the lung lining).

Information on the perceived risk of cancer by asbestos is conflicting. While, evidence from Hodgson and Darnton (2000) in their study on Quantitative Risks of Mesothelioma and lung cancer in Relation to Asbestos Exposure and HSE Site Safe news (2008) suggests that asbestos can also cause laryngeal cancer and may be implicated in causing pharyngeal, stomach and colorectal cancers, and that there is a link between asbestos and illness called Mesothelioma, i.e. lung cancer. The California Department of Health Services also affirms that there is health effects associated with asbestos as a result of inhalation of the asbestos fibers. On the other hand California Safe Drinking Water and Toxic Enforcement Act of 1986 reported that the use of Asbestos Cement products had not been demonstrated to be a health threat. In view of this, the California Waterworks Standards allowed for the use of Asbestos Cement Pipe. Texas Department of Health Services (1988) claimed there was no health risk related to the use of asbestos products and routinely approved engineering submittals calling for A.C. Pipe.

## **BANNING OF ASBESTOS**

In 1989 EPA (USA) banned Asbestos. In 1991 the US Courts (Fifth Circuit) vacated and reversed this EPA's ban claiming that EPA's analysis was unscientific and incomplete. In the same year, EPA issued final drinking water standards, wherein asbestos cement pipe was allowed conceded that the risk posed by Asbestos substitutes, such as PVC and ductile Iron pipe, were far greater than those posed by A.C. Pipe.

In the United Kingdom, in 1970 the asbestos industry maintained a voluntary ban on the import of raw blue asbestos into the UK. Then in 1980, they agreed to a similar ban on brown asbestos. The UK government finally imposed a legal ban on both blue and brown and any products containing them, in 1986. An attempt to introduce a phased ban on the use of asbestos in the European Community was narrowly defeated in March 1987. In 1992 Asbestos (Prohibitions) Regulations amended to include ban on rarer forms of Amphibole asbestos (Tremolite, Actinolite and Anthophyllite) (Control Of Asbestos At Work (Amendment) Regulations 1992).

Evidence from the work of Ferret and Hughes (2008), on Health and Safety in Construction, made it clear that, asbestos related diseases are responsible for around 4,000 deaths in the UK each year.

This paper investigates into the efforts of the Government of Ghana on the regulation concerning the use and manufacturing of asbestos cements products in Ghana and also to find out whether Ghanaian public is aware of the hazards associated with asbestos products. This calls for the need to investigate into the regulatory position of Ghana Government and also to ascertain if there is a continuous use of asbestos cement products in Ghana using Sekondi Takoradi as a case study area.

## **RESEARCH METHOD**

Combination of quantitative and qualitative research methodology was used in this research. Data obtained for this research was through field work and questionnaire combined with interviews.

### **Field work**

The field work was used in this research to assess the evidence on the use of asbestos cement products in the construction of dwelling houses in Ghana with Sekondi-Takoradi as a case study area. Five selected newly developed areas in Sekondi Takoradi Metropolis were used for this study namely; Race course ridge, Anaji Namibia, Anaji Estate, Kojokrom new site and Apollo. The purpose for selecting these communities was that, these communities started developing when the dangers of using asbestos-cement product were known to the building regulatory bodies (like Building inspectors, Town and country planning, and Ghana standard board), Engineers, Architects and contractors, yet there was continuous use of asbestos roofing sheet in these areas.

The fieldwork also served as an overview of the asbestos problem, by assessing the opinions of house owners in the five selected areas with the focus of creating awareness of the dangers in the use of asbestos. The field work also aimed at advising those who have asbestos materials present in their premises on how to manage the risk so that no one will unknowingly disturb it and also provide information about the material to those who are likely to disturb it. During the field work, three simple questions were asked to assess the knowledge of owners and dwellers of houses with asbestos cement roofing sheets as roof cover.

### **Questionnaire**

A combination of interview and questionnaire approach was used in collecting data for this research beside the field work. More often than not, the response to interview approach of administering questionnaire in data collection is much higher than the postal questionnaire approach (Naoum 1998). Chief Executives and Directors from the under listed organizations were interviewed:

1. Cemonit Gh. Ltd.- (asbestos manufacturing company)
2. Ghana Medical Services
3. Ministry of Health
4. Korle BU Teaching Hospital
5. Trade Union Congress (TUC)
6. Building and Road Research Institute (B.R.R.I)
7. Ministry of Resources, Works and Housing
8. Ghana Standards Board
9. Public Works Department
10. Food and Drug Board
11. Ministry of Justice-Judiciary Service
12. Ministry of Justice – Attorney General
13. The Parliament House
14. Komfo Anokye Teaching Hospital
15. STMA (Local Authority in Sekondi Takoradi)

In all, 20 persons from these organizations responded to the questionnaire. They include four members of parliament, two from Ghana Standard Board, three Medical practitioners, two from Cemint Gh Ltd, and one each from the rest of the organizations. The Personnel from the above named organizations were given statements that were related to the Practice and Control of asbestos in the construction industry, which are elaborated in Section 3.2. The respondents were given the choice to express their degree of agreement or disagreement on a particular statement. The set of response quantification categories are as follows: strongly agree (5 points), agree (4 points), neither/nor (3 points), disagree (2 points) and strongly disagree (1 points).

There was separate questionnaire for personnel in the manufacturing company. These questions were designed to solicit information from “Cemonit Ghana Ltd”, the only asbestos cements products manufacturing industry in Ghana.

## ANALYSIS OF RESULTS

This section describes in details the outcome of the research in the field work, questionnaire and interview that were conducted.

### *1. Results from field work*

Table 1 contains the data obtained from the field work conducted in the five selected communities namely; Anaji Namibia, Anaji Estate, Race Course Ridge, Apollo and Kojokrom new site

Table 1 Houses in the five selected communities

Community	Starting Date of the community	No of housing units	No of houses roofed with asbestos sheet	Percentage of houses roofed with asbestos sheet
Apollo	1984	1000	230	23
Kojokrom new site	1995	1000	420	42
Namibia	1980	1000	620	62
Race course ridge	1996	1000	210	22
Anaji- Estate	1972	1000	760	76

From the data in Table 1 it was evident that the percentage of houses with asbestos cement roofing sheets in the five selected communities was on the average about 450. Anaji Namibia and Anaji Estate have 62% and 76% respectively, of houses roofed

with asbestos cement roofing sheet. These two communities were developed by State owned cooperation, now, State Housing company. Anaji Estate and Anaji Namibia were developed in the late 70's and early 80's respectively, a period when the health hazards on the use of asbestos products were known. Apollo, Kojokrom New site and Race course Ridge have percentages of houses roofed with asbestos to be 23, 42, and 22 respectively. These communities were developed in the 80's and 90's by private individuals. If the government of Ghana had acted earlier on legislation regulating asbestos products and also had created awareness on the hazard associated with asbestos products, these individuals might not have roofed their houses with asbestos cement roofing sheets. Landlords were interviewed during the field survey. In all, ten landlords were interviewed in each of the five selected areas. The questions asked are summarized below:

- Why did you use asbestos cements roofing sheet on your building?
- Are you aware that asbestos has some health risk hazard?
- If you were to build a house again would you use asbestos cements roofing sheet

Asking why you used asbestos cements roofing sheet on your building. Twenty landlords from Anaji Namibia and Anaji Estate said they did not take part in the decision on the use of asbestos, since they bought their house from the Government. 24 landlords from Apollo, Kojokrom New site and Race course Ridge answered that asbestos roofing sheets were relatively cheaper and could withstand the effect of the sea breeze. While, 6 landlords said they were advised by the construction workers working on their buildings. When asked whether they were aware that asbestos had some health hazard. Half of the respondents were not aware while a quarter of them were aware. The last quarter of the respondents had heard of the health risk but did not believe it was true.

If you were to build a new house, would you use asbestos cements roofing sheet? To this question three-quarters of the respondents answered no, while, a quarter appeared indifferent. The response to the last question indicated that at least the interaction with some of the Landlords had created certain level of awareness on the health risk related to the use of asbestos cements products.

A separate interview with the State Housing company revealed that about 1200 housing units roofed with asbestos cement roofing sheet were constructed by State Housing cooperation (The State owned construction company) from 1976 to 2000 in the Sekondi-Takoradi Metropolis (about 12000 nationwide), a period when the risk of asbestos was known in Ghana.

## *2. Details of the responses to the questionnaire*

Two separate questionnaires were given to two set of groups namely; chief Executives of selected Government Agencies and directors of the asbestos manufacturing Company.

### *a. Responses from Chief Executives from Government Agencies*

Table 2 is the ranking data of the ordinary scale measure, the numbers assigned to the agreement or disagreement scale (5, 4, 3, 2, 1) do not indicate that the interval between the scales are equal nor do they indicate absolute quantities. They are numerical labels. Each opinion question in the table requires the respondent to indicate strongly agree (coded 5), agree (coded 4), neutral (coded 3), disagree (coded

2) or strongly disagree (coded 1). A total of 20 responses were received from 20 Government organizations and manufacturers. They included four members of parliament, two Directors of Ghana Standard Board, three Medical practitioners, two Directors of Cemint Gh Ltd, and one representative each from the rest of the organizations. The responses to the questionnaire are summarized in Table 2.

Table 2. Response of questionnaire

Questions	SA	A	N	D	SD
1	8	11	1	0	0
2	9	10	1	0	0
3	8	11	1	0	0
4	2	16	2	0	0
5	7	10	3	0	0
6	14	4	1	0	1
7	15	5	0	0	0

SA -Strongly Agreed, A- Agreed, N- Neither agreed nor Disagreed, D- Disagreed, SD- Strongly Disagreed

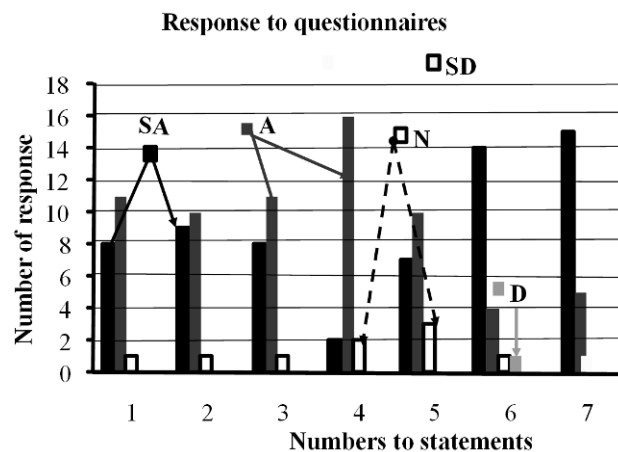


Figure 1: Bar chart of respondents to questionnaire (personnel from government agencies)

The following statements were the contents of the questionnaire:

1. Statement 1- "Asbestos is the genetic term for a wide range of minerals that crystallize to form fibres. Most common is the white, blue and brown asbestos."

With reference to Table 2 all the respondents agreed to the statement, meaning, the term asbestos is very familiar. It should be said that most of the respondents were professionals with knowledge in construction or medicine.

2. Statement 2 – "Although asbestos is a hazardous material it can only poses a risk to health if the asbestos fibres become airborne and are then inhaled".

Considering the responses to this statement, many of them understood the problem caused by asbestos material. The literature of the statement explained further to respondents the hazardous nature of this material and how one could be exposed.

From Table 2 and Figure 1, 19 out of 20 responses, at least agreed to the statement. One respondent confirmed that the question was not quite clear, hence, remained neutral to the statement.

3. Statement 3 – ‘‘For a long time the dangers on the use of asbestos were not widely understood. Asbestos related disease generally takes many years, often several decades to develop exposure. Thus, the scale of the health risks was only becoming known after asbestos had already been widely used and many people had already been exposed’’.

With reference to Table 2 and Figure 1, the respondents who neither agreed nor disagreed said that she was not quite familiar with the statement. All the rest agreed with eight expressing their strong agreement to the statement.

4. Statement 4- ‘‘As asbestos fibres accumulate in the lungs, several diseases may occur

- Mesothelioma is a cancer of the pleural and peritoneal lining
- Lung cancer is a malignant tumor of the bronchi
- Asbestosis is a scarring of the lung tissue
- Diffuse pleural thickening is a non-malignant disease.
- Small areas of scarring are called pleural plaques’’.

This statement explains the diseases which are caused as a result of asbestos exposure. All the respondents agreed with the statement except one respondent who was not sure about the statement. This respondent remains neutral to the statement.

5. Statement 5 ‘‘The highest mesothelioma risk in the UK and the EU today is seen in occupations predominantly associated with construction and building maintenance highlighting a shift away from the traditional asbestos industries of the past’’.

The statement gives analysis on the highest risk of exposure to asbestos pertaining to various occupations. The occupations are mostly Carpenters, Plumbers, Electricians, Labourers and other construction trades, construction operatives, and managers in construction, the highest mesothelioma risk of asbestos being construction workers. This statement brought into view, the need to manage asbestos in the work place to ensure safety among workers.

With reference to Table 2 or Figure 1, it could be shown that three respondents neither agree nor disagree with the statement due to lack of knowledge about the information provided by the questionnaire. At this point of the interview, respondents expressed their excitement and were alarmed on this information if it turns out to be true.

6. Statement 6- ‘‘There is a ban on the use of asbestos products such as asbestos cement sheets, and any product containing asbestos materials in the UK and the EU countries. Do you think that Ghana should follow this example’’?

The question sought to know if measures being put in place in the UK and the EU countries to reduce risks from asbestos would be equally appropriate to be applied in the construction industry in Ghana. The results recorded two respondents, of which one marked neutral whereas, the other disagreed on the ban of asbestos cement materials in Ghana.

7.Statement 7 –“Your organization can contribute in the management of the Asbestos problem by way of raising awareness, initiating legislation on the control and if possible ban the use of Asbestos products in Ghana”.

The idea underlying the statement was to persuade the legislature and chief executives of Government Department to use their position to influence the making and implementing of an Act of law regulating or possibly banning the use of asbestos products in Ghana as in the United Kingdom and the European Union countries.

The general consensus of the respondents was in total agreement with this statement. The respondents of the questionnaire comprised some parliamentarians and chief executives of selected Government Departments. From their responses to the statements in the questionnaire it could be sum up that if people, particularly workers involved in construction and maintenance have the potential to be exposed to asbestos, then Ghana should consider enacting a law banning the manufacturing, importation and the use of asbestos products .

From the discussions the authors had with the respondents showed that some professionals in the construction industry did not have an in-depth knowledge about the hidden killer- Asbestos. However, it is feared that, until enough campaign or awareness is created on the health risk of asbestos products, many people could be exposed to the health hazard.

*a. Questionnaire for Manufacturing Companies*

The only manufacturing of asbestos products in Ghana (Cemonit Ghana Limited) was asked to answer the following questions in the questionnaire.

1. What is the core business of your company? The question seeks to obtain an idea about the operations and activities of the company.
2. How long has your company been in production in Ghana? The question requires history of the company, the extent of existences of asbestos products in the country.
3. State whether your company is the only firm producing asbestos fibres reinforced product(s). This question seeks to determine the number of Asbestos products manufacturing companies in the country.
4. What are some of the factors contributing to the widely use of Asbestos products in Ghana? The question seeks to find out why people use asbestos products and why are the products so popular in Ghana.
5. Give brief outline description of the manufacturing of Asbestos products and/or provide sample of materials for the production of one Asbestos product”. This question was asked in order to establish the fact that there was



presence of asbestos material in their products, and if possible to identify types, and constituents of asbestos material being used in the manufacturing of asbestos products in Ghana.

6. Are you aware of any health hazard associated with the use of asbestos products -This question sought to establish whether people were aware of the health risks associated with asbestos and also as a reminder to producer to act on the issue in question.
  7. Following a ban on the use of asbestos in the European Union and the UK due to the known occupational health hazard caused by asbestos fibres, what would you use to replace asbestos product to satisfy your numerous customers incase asbestos banning regulation is enforced in Ghana? This last question was to emotionally prepare management to think of alternative material to asbestos, should there be any ban.
- b. *Summary of the manufacture's responses* The respondent stated that, their activities were the manufacturing of asbestos cement based products including roofing sheets and pipes and that it was the only manufacturing company of asbestos products in the country and had been in operation for 20 years.

It was also revealed that the firm could not meet the demand of their customers and this had compelled the Government to allow importers to import asbestos cement products into the county. This then implies that the asbestos products are widely used in Ghana despite its health hazards.

In an attempt to find out the reasons contributing to the widely use of asbestos cement products in Ghana. Answer to this question (Question 4) was that asbestos cement products were cheaper and durable. The manufacturer also added that the hazards associated with asbestos products were not known to the general public. It was also certain that the manufacturer (the respondent) was aware of the health problems associated with asbestos cements products so had put precautionary measures in place to control the risk to the workers and the surrounding community being infected by any asbestos related disease. According to the respondent their products are manufactured in the wet state, and this eliminates dusty particles into the atmosphere. The respondent also emphasized that there was regular medical examination for all workers.

Finally, on the question, 'whether asbestos products should be banned in Ghana? The respondent could not give a précised answer, however, responded that they did not expect any ban on their products. The reason for their opinion, being that since their company adopts a wet process system in the preparation of its products, there was likelihood that the hazard was largely eliminated, and this could warrant their continued existence in business.

The conflicting views from literature make it inconclusive to demonstrate a health effect from asbestos products. However, the authors took a bias position that asbestos products pose health hazard. This is evident from the type of questions or statements in the questionnaire.

## **REGULATORY POSITION REGARDING THE USE OF ASBESTOS IN GHANA**

The Ghana Standards Board is the regulatory body in Ghana. It gives certification for Cement Based Construction Products in accordance with the certification Mark, Rules 1970 LI 662. The certificate is an attestation of a product's compliance with specified requirements of a

relevant standard. In an interview with officials of GSB, it was clear that the Ghana Standards Board continues to give approval to manufacturers of asbestos cement products, and this had made asbestos manufacturers and importers to continue to promote and develop asbestos cement products in the country.

When the authors visited the manufacturing industry, Cemonit Ghana Ltd, it was learnt that asbestos cement roofing sheet produce in Ghana had asbestos to cement ratio of 1:10. Surprisingly, this asbestos/cement ratio was not known to The Ghana Standards Board. However, The Ghana Standards Board was certain that the asbestos/cement ratio of asbestos of asbestos products, produced in Ghana was insignificant. This according to the official makes the products virtually cement based and not asbestos based. The Ghana Standards Board classifies asbestos cement roofing sheets produce in Ghana as 'Cement based product' and therefore not dangerous.

It was learnt from the discussion with The Ghana Standards Board that there were no stringent measures on safe working policy at construction work places. This is a threat to the health of construction workers. The Ghana Standards Board has no legislative instrument or bylaws prohibiting the manufacturing, importation and the use of asbestos cement products in Ghana.

## **CONCLUSION AND RECOMMENDATIONS**

A research was conducted with the main aim of investigating the regulatory position regarding manufacturing, importation and the use of asbestos and also to assess the evidence of the continuous use of Asbestos cement products in the construction industries in Ghana, using Sekondi-Takoradi as a case study area. This research was conducted to ascertain the continuous use of asbestos roofing sheet irrespective of the associated health hazard; hence field work survey was conducted. The research also tried to find out whether regulating bodies, other government agencies, landlords and manufacturers of asbestos products were aware of the risk related to the use and manufacturing of asbestos cement roofing sheet. This led to questionnaire and interview of some personnel of the aforementioned enterprises.

In the Fieldworks survey in the five selected communities in Sekondi-Takoradi, it emerged that out of every 100 housing unit at least 40 of these housing units were roofed with asbestos cement corrugated roofing sheet. The research unveiled that more than 50% of Landlords interviewed had at least, heard of the health risk associated with asbestos product, but did not consider it harmful since the asbestos material have not been disturbed and hence no release of asbestos fibres which when inhaled into the lungs could cause cancer. The outcome of this research also indicated that there were no regulations prohibiting the use of asbestos products in Ghana, rather the regulating agency (The Ghana Standards Board) continued to give permit to manufacturers of asbestos cement products and this had led to the asbestos producing industry in the country to continue to promote and develop its products and the importation of raw asbestos into the country. The Ghana Standards Board classified asbestos cement product produced in the country as cement based hence minimum health risk.

In contrast to the opinion expressed by the personnel of Government Departments the manufacturing industry were not in favour of the promulgation of asbestos regulation that would prohibit the promotion and development of asbestos cement products.

The research recommends that those living in building roofed with asbestos cement roofing sheet or have asbestos materials present in their premises, should firstly, check the condition

of the asbestos products, secondly assess the risk from any asbestos containing materials. Thirdly take action to manage the risk so that no one will unknowingly disturb it and finally, provide information about the material to those who are likely to disturb it.

This research found out that there was a continuous use of asbestos roofing sheet in Sekondi Takoradi irrespective of the associated health hazard and also there was no regulation regarding the manufacturing, promotion, importation and the use of asbestos cement products. The way forward would be to conduct a comprehensive interview with parliamentarian and to let them see the need to make a law regulating the use, promotion and the importation of asbestos cement products, if possible ban the use of asbestos cement products in Ghana.

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# THE DISPROPORTIONAL REPRESENTATION OF BLACK AND MINORITY ETHNIC PEOPLES' (BMEs) EMPLOYABILITY IN CONSTRUCTION: A REVIEW OF LITERATURE

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The construction industry accounts for a substantial part of every country's economy. It is a major contributor to the GDP and a primary source of employment to a substantial section of the population creating, in effect, secondary employment for activities associated with it. The globalisation of the world has meant that the mobility of human and capital resources addresses the imbalance in the distribution of the world's resources as the developed world has a larger share of the global construction output while the developing world abounds in the supply of labour. This, on one hand, has resulted in the need for labour to move from one country to another to fill vacant jobs while on the other hand, certain countries like the UK has, in the past, seen a high level of immigration which has resulted in a more diverse society especially concentrated in certain parts of the country. Consequently, it is anticipated that the construction industry should have become progressively multicultural to reflect this diversity. This paper therefore attempts to probe the factors that inhibit the proportional representation in the industry even when it makes economic sense to fairly engage BMEs in the sector in view of the shortfall in skill labour supply.

Keywords: BME, culture, employee retention and progression, employment, globalisation.

## INTRODUCTION AND BACKGROUND

The construction industry, as defined by the Association of Colleges London Region (2008), is responsible for every type of work involved with building. As a result, there are jobs generated at every stage in the life of such building - from designing and planning projects, to building, altering, decorating, restoring and maintaining them and in addition end of life demolishing. The global construction industry is constantly changing and is client focused requiring timely completion of work within budget. Consequently, globalisation has caught up with the industry that requires mobile labour force with goods and services increasingly sourced internationally as a result of the global distribution of construction labour and output (Flanagan and Jewell, 2004; ILO, Sectoral Activities, 1998). The Engineering News Record (2005), valued global construction output at over US \$3.6 trillion in 2003. And, withal, this could be said to be an underestimation considering the limited statistics in developing countries. In Europe, the UK ranks third in construction output after Germany and Italy and with US \$212 billion while in Asia, Japan and Korea had had a significant construction output which has been overshadowed by the recent recession proof growth in China

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and India in particular, growth which lifts the region's construction output by an additional 2.6% even in the worst recession in recent history (Sleight, 2009; Flanagan and Jewel 2004).

The UK construction industry is the main contributor accounting for approximately one-tenth of her Gross Domestic Product (GDP) and provides over half of the fixed capital investment (Steele and Todd, 2005). Being Britain's largest industry and the third largest in the EU, (Ahmed et al, 2008; Dainty et al, 2007; DTI, 2007) construction employs nearly 2 million people and there are also a large number who are indirectly engaged by the industry, creating a whole range of secondary employment which relies on a prosperous construction industry (Ahmed, et al 2008). Support, in the form of recruitment events, training, mentoring, professional networking, as well as work placement and experience schemes, expedites entry, retention and progression within the construction industry (Ahmed et al, 2008). The UK construction sector contributed 9.2% of the nation's Gross Value Added (GVA) in 2007 according to the Department of Trade and Industry (2007). The industry consists of over 250 000 firms employing 2.1 million people in a multitude of roles with a sector defined as one which embraces the construction materials and products; suppliers and producers; building services manufacturers, providers and installers; contractors, sub-contractors, professionals, advisors and construction clients and those organisations that are relevant to the design and build operation and refurbishment of buildings.

However, this well acclaimed industry has, traditionally, relied on young white males to form the majority of the workforce (Ahmed et al, 2008; Duncan, 2005; Agapiou et al, 1995). As a result, minority groups, especially Black and Minority Ethnic people (BMEs) have been under-represented within the trade and professional occupations within the industry. Yet, demographic forecasts for the UK have indicated that the proportion of the BME labour supply will become increasingly prominent in future, particularly as the BME age profile is skewed towards young age groups (Ahmed et al, 2008; Ogbonna et al, 1995,). Faced with shrinkage of the traditional pool of applicants, as a result, the construction industry needs to look towards under-represented groups, such as those from the BME communities, to fill the ever growing vacancies within the industry. Thus, the participation of BMEs in the construction industry is vital in terms of meeting the industry's demand for labour and the shortfall of skills which creates strong opportunity for BME people to take advantage of the current skills shortage. However, this does not appear to be the case as BME consultants and contractors still continue to face barriers that limit their chances to take advantage of the growth in the construction based industry as indicated by Steele and Todd (2005).

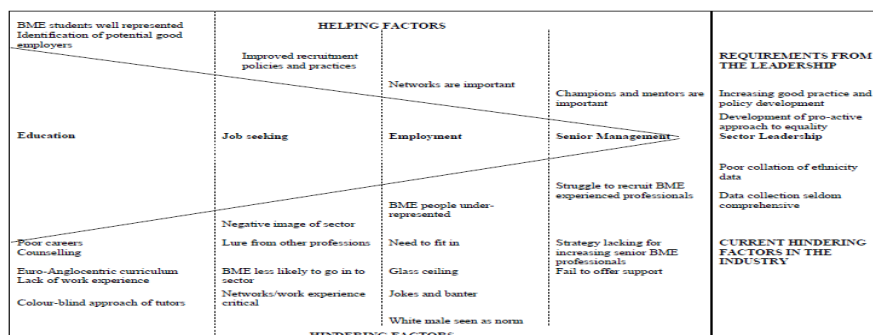
Therefore, construction has been identified as a major industry in every economy and one of the most significant sources of contribution to employment and GDP. In almost all economies, especially in the developed world, it makes up the considerable share of overall activities and its influence is felt in every sector of the economy from transport through mining to services. As construction resources are more located in the developed world, it tends to be more attractive to BMEs from other less developed nations looking for lucrative sources of income and as a result migrate to these places. Also, the tendency to be discriminated against is higher as BMEs in most cases are seen as taking, rather than contribution to the host's country's economy. This problem of discrimination affects minorities at all levels, from the immigration to the first and subsequent generations, as well as their business. The problem is much compounded

and, as a result, requires coordinated efforts from all stakeholders concerned to ensure an optimal solution. As BME cultures tend to be blamed for most of such problems, as a result of the lack of understanding of these cultures, coupled with the fact that the amount of research in the field is limited vis-à-vis the scale of the problem, it is important that more studies are conducted in the area in order to develop a good understanding for appropriate recommendations for redress.

## FACTORS CONTRIBUTING TO BMES UNDERREPRESENTATION

Although, the image of the construction industry itself has been found to be a major barrier for entry into construction (Ahmed et al, 2008, CAGE, 2005), culture, language and religion also form immense barriers for a range of ethnic minority people. A report, commissioned by CAGE (2005) on Minority Ethnic Representation in the Built Environment professions in a research by the Centre for Ethnic Minority Studies at Royal Holloway, University of London, sought for answers to the many questions and attempted to explain the barriers facing black and minority ethnic (BME) professionals pursuing careers in the built environment. In it a model (figure 1) below which highlights the key issues either helping or hindering access to and progression as well as retention in the industry for BMEs is unveiled. Here, attempts are made at the various stages of the process from education through job seeking and employment to retention and progression to senior management with the helping and hindering factors at each stage well outlined. It is evident that in the process very few BMEs ever make it as indicated in figure 3 due to the many barriers in their way.

Figure 1: BME Helping and Hindering Factors into Construction Employment



Source: The Commission for Architecture and the Built Environment (CAGE), 2005.

Additionally, the report calls on professional bodies, large employers and sector organisations to develop clear policies on equality and diversity and implement action plans for sufficient monitoring. The report also advises employers to review their recruitment policies and procedures, building on existing best practice, with the aim of making the sector's recruitment processes more inclusive. Related to the factors above are others already mentioned in the previous section and these are discussed below.

### Culture

According to Schein, (1992) culture surrounds us all. Cultures are deep seated, pervasive and complex (ibid). Furthermore, culture has been proposed as 'the way in which a group of people solves problems and reconciles dilemmas' (Trompenaars and Hampden-Turner 1997). It is generally the way of life characteristic of a people and has also been said to be 'how we do things around here' (ibid). People's cultural traits are shaped by the various institutions they come into contact with, the culture of

which has made them. Every institution has its own unique culture which is what identifies it from the rest, giving it its unique characteristics.

### **Societal and National Culture**

The first aspect of culture is taken in a broader sense and considers the characteristically unique beginnings of lifestyles of a particular group of people which have moulded their ways of doing things, which characteristics define them as a society. These lifestyles are manifested in sets of shared attitudes, values, goals, and practices that characterize the group and when bordered in defined boundaries results in the classification of nations constituting a particular society or group of societies. Hofstede (1980, 1991) defines national culture as ‘the collective mental programming’ of the people of any particular nationality. He suggests that people share a collective national character which represents their cultural mental programming which in turn shapes the values, attitudes, competences, behaviours, and perceptions of priority of that nationality. Also, Fukuyama, (1995) defines it as an ‘inherent ethical habit’ which consists of an idea or value, or of a relationship. These ideas, values, and relationship patterns constitute the ‘ethical codes’ by which societies regulate behaviour as they are nurtured by repetition, tradition, and example which are reinforced through images, habits and social opinions (Morden, 1999).

Furthermore, the influences of national cultures have been said to shape strong value systems resulting in shared values, preferences, and behaviour of population groups which differ widely between countries (Katz, 2005). The term ‘national culture’ can therefore, be misleading as it is also the case between different subgroups within a country that it may only be referring to part of the people in that given country an example in this case being that of Hofstede’s generalisation of UK culture whereas in fact it is made up of distinctive cultures of the four constituent countries. National culture has been conceptualised by Hofstede (1980, 1991) which he treats as implicit; core; systematically causal; territorially unique; and shared. Like organizational culture (Cameron and Quinn, 2005; Peters and Waterman, 1982; Schein, 1985) national culture has been extensively researched (Hall 1990; Hofstede 1980, 1998, 2005; Trompenaars 1998, 2003).

Consequently, it can be said that cultural orientation forms the basis of the behaviour of people and this determines their perception of other cultures and the world around them. So, it is important to stress that, unique and shared characteristics which are classified as cultural traits identify a group of people from any others. Therefore, it follows that in order to perform creditably; there is the need to learn new values, attitudes and a general way of doing things in characteristically different environments as some learned practices may need to be unlearned. Additionally, it is ethical that difference is acknowledged and recognised as a diverse way of life. This forms the basis for tolerance so that a process of adaptation and mutual coexistence can take place; a process known as acculturation.

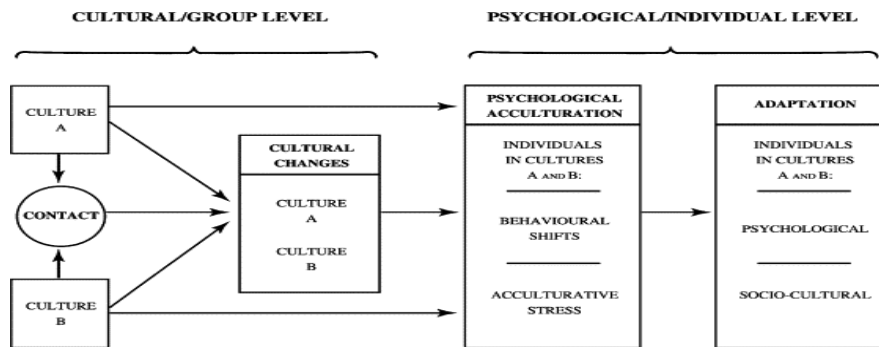
#### *The Process of Acculturation*

Acculturation, according to (Berry, 2005), is the dual process of cultural and psychological change that takes place as a result of contact between two or more cultural groups. Subsequently, in order to understand individual behaviours leading to the discriminating culture in construction, it is important to also understand the different cultures that come into contact in the industry. This process of examining cross-cultural contexts (Berry et al, 2002) which results in acculturation is shown in figure 2.2 below which reinforces the acculturation process with the example of the



two culture-level phenomena, referred to as the society of origin (A) and society of settlement (B), and their respective features after cultural transformation resulting from their contact in (A and B). In order to understand the process, the characteristics of the individuals involved must initially be established to allow an appropriate comparison of the degree of voluntariness in the process.

Figure 2: A general framework for understanding acculturation.



Richmond (1993) argues that migrants can be arrayed on a continuum between reactive and proactive, with the former having exclusionary motivating factors generally negative in character, and the latter having enabling factors generally positive in character which migration motivation refer to as push/pull factors.

Conversely, there are the general orientations that a society and its citizens have towards immigration and pluralism. Berry, (2005) notes that some societies have been built by immigration over the centuries, and this process may be a continuing one, guided by a deliberate immigration policy. Therefore, the important issue in the process of acculturation is both the historical and attitudinal situation faced by immigrants in the society of settlement. Some societies are accepting of cultural pluralism resulting from immigration, however, even where pluralism is favoured the level of acceptance of specific cultural, racial and religious practices may vary as indicated in Berry and Kalin, (1995) and Lebedeva and Tatarko, (2004) and according to Berry, (2005) those groups that are hardly accepted often experience hostility, rejection, and discrimination, yet it must be stressed that the situation can be precarious and very unpredictable.

Ergo, as the factors above bear on the actors performance in construction organizations, it is worthy of note that the numerous professions that come together to complete a particular project each exhibits unique cultural traits which differentiate them from the others and so for one to be part of such a group, it is important that such traits are learnt through the laid down processes and procedures. Notwithstanding, there is the need to recognize that inherent differences exist between individuals and groups and it is only on the basis of such recognition that there can be mutual coexistence and teamwork for the attainment of common aims.

### Occupational culture

Cultures arise among groups of individuals who share similar ideologies and forms of expressing those ideologies in speech and behaviour (Trice, 1993). Employees who practice the same profession tend to band together into occupational communities, draw their identities from the work they do and proceed to share a set of values, norms and attitudes which collectively form a part of the culture of that occupation (Van Maanen, 1984). As these employees from a particular occupation work towards the organisation's common goal, their distinct ideologies accentuate the behaviour that

works best within the context of their occupation (Guzman et al, 2004). Over time, each subculture within an organisation may manifest its own beliefs and practices that distinguish it from other groups in the organisation justifying Trice's (1993) assertion about the assumption that an organisation is homogenous in nature, although it may contain numerous subgroups that manifest variations of cultural forms and ideologies. In their study of culture, Brockmann et al (1999) comparing the cultures of construction and manufacturing use the words professional and industry culture as synonyms which brings into focus the definition of Schein (1985).

Schein's (1985) definition,

"The pattern of basic assumptions that a given group has invented, discovered, or developed in learning to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid, and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to these problems."

has been said to be applicable to organizational culture as well as occupational culture yet Brockmann et al (1999) note, that there are different forces at work coining either an occupational or an organizational culture.

Outside as well as inside pressures form occupational culture in a similar way to organizational culture. The practices of engineers are formed by environments such as apprenticeship, technical school, university, work, and of course also by organisations with a cultural influence of professions (Mackie 1988). While considering the three frameworks set by Hofstede (2005), Riley and Clare-Brown (2001), and Woodward (1965) the occupational culture of civil engineers and mechanical engineers are evaluated and found to be distinctively different as are their organizations, their management, and their technology and cultural change is only possible with changes in the respective environments where they operate as figure 2.3 below attempts to demonstrate.

Figure 3 Enculturation Process of BMEs into Construction Organisations

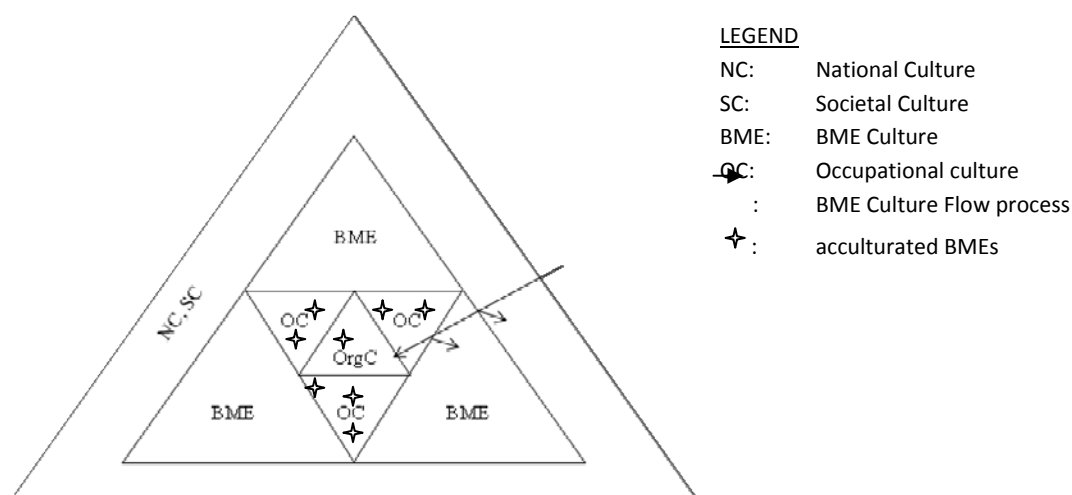


Figure 3 shows the cultural flow process of BMEs from their individual external cultures into the various cultures of the host nation, its occupational and organizational cultures and the processes of absorption and rebounds. As BMEs enters the host nation the whole array of cultural perspectives impact on both the host and the hosted with the resultant possible acceptance or rejection.

The foregoing has considered, *inter alia*, the institutions involved in the formation of the unique practices characteristic of a profession which forms the basis for the ways actors and participants behave and do things. As these are what brings to bear in their performance in organizations, it is worthy of note that, as already been mentioned in section 1, the numerous professions that come together to complete a particular project will each exhibit unique cultural traits which differentiate them from the others and that for one to be part of such a group, it is important that such traits are learnt through the laid down processes and procedures. Notwithstanding the fact that occupational culture tends to be generally universal and characteristic of a profession, differences tend to show from nation to nation and organization to organization resulting in a level of uniqueness about this whole process.

The next subsection considers organizational culture. People are employed in organizations or even if self-employed work for organizations, a reason for which the culture in such organizations is very important if BMEs are to progress here and for this reason this aspect of the study will be discussed in-depth.

### **Organizational culture**

Despite different definitions of organizational culture, there is a consensus among organizational researchers that it refers to the shared meanings or assumptions, beliefs and understandings held by a group. More comprehensively, Schein (1992) defined organizational culture as a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration that has worked well enough to be considered valid and therefore to be taught to new members as the correct way to perceive, think and feel in relation to those problems. Cameron and Quinn (1999) propose that what differentiates successful firms from others is their organizational culture since the ability to understanding organizational culture is the basis to examine what goes on in organisations, how they are ran and improved as suggested by Schein, (1992). With the worldwide globalization trends, special attention has been given to the study of organizations and their cultures. Empirical studies of organizational culture have been carried out across various countries and industries (Hofstede, 1997; Trompenaars and Hampton-Turner, 1998; Cameron and Quinn, 1999), yet not much has been done in this area relating to the number of published studies in project-based industries such as construction (Ankrah and Langford, 2005; Low and Shi, 2001; Zhang, and Liu, 2006; Oney-Yazici et al, 2005).

In fact, the extensive study of organizational culture convinced Ankrah and Langford (2005) to emphasize a need to become more aware of the importance of this phenomenon and its impact on organizational performance in the construction industry. Furthermore, globalisation and access to international markets entry (Low and Shi, 2001) as well as the fragmented nature of the industry (Hillebrant, 2000) are major reasons for the growing importance of organizational culture in construction. It is a well-known fact that international construction firms have faced many problems due to conflicts, confrontations, misunderstandings, and the differences in ways of doing business with other cultures (Gould and Joyce, 2000). On the other hand, conflicts between different project participants are assumed to be influenced by the cultural orientations of the stakeholders (Phua and Rowlinson, 2003). Thus, the study of cultural issues should be addressed when considering the globalization of construction markets. This said however, it is important to stress that organizations that have developed within similar environments usually have similar cultures and related mindsets with regard to ways of doing business.

Also, with the help of Handy's organizational culture and Hofstede's national culture frameworks, Rowlinson (2004), after analyzing all cultural dimensions and typologies developed in the literature by Ankrah and Langford (2005), investigated the cultural aspects of organizational change in the construction industry and proposed a new measurement tool highlighting the cultural variability between organizations on construction projects. In addition, Oney-Yazıcı et al, (2006), upon reviewing literature concluded that despite the growing importance of organizational culture in construction research, there are few cross-cultural, empirical studies which they attribute to the difficulties of conducting research in several countries characterised by a multiplicity of cultures.

Thence, the above discussion of organisational culture highlights the variability of culture/practices between organisations on construction projects. It reinforces many authors' works on the diversity of cultural practices within organizations across nations and societies and the impact of such practices on organizational performance in construction. Additionally, globalisation and access to international markets as well as fragmentation of the industry are major reasons for the growing importance of organizational culture in construction. It is a well-known fact that international construction firms have faced many problems due to conflicts, confrontations, misunderstandings, and the differences in ways of doing business with other cultures. On the other hand, conflicts between different project participants are assumed to be influenced by the cultural orientations of the stakeholders.

#### *UK Construction Industry Organisational Culture*

The UK construction industry has been viewed as being both hierarchical and fragmented by Barthorpe et al (2000) sharing strong characteristics with adhocracy organisations as outlined by Cameron and Quinn (2006). These fragmentations include the many sole traders, small businesses and differing job roles, that are often short term and contractual in nature and exist within manual, managerial and/or professional roles where there is a greater focus upon financial rather than people management issues and concerns (Dainty et al, 2007). The inherently masculine culture that is dominated by White males is maintained within this fragmented and highly competitive organisational climate with poor levels of communication and this in turn negatively impacts upon public perceptions of the construction industry (Latham, 1994).

The vast majority of companies consist of small and medium sized enterprises (SMEs) that are constantly vying for short-term and one-off contracts, with a focus upon taking on sub-contractors to save on costs, rather than investing in and supporting permanent staff. This type of highly competitive and unsupportive culture acts as a deterrent for entry into the industry by both women and BMEs (Gale, 1992). The small number of large companies that exist within the industry, with very few directly employing permanent staff has also been stressed by Dainty et al, (2005).

Consequently, the failure to promote good race relations has resulted in pressure being put on ethnic minority staff to conform to a white 'norm': not just as a way to get on with white senior management, but to ensure that they fit in social situations and events, for example, dressing according to Western standards and codes (Ahmed et al, 2008). Socialising with work colleagues, recognized as important to career progression and as part of work ethos, impacts disproportionately on some ethnic minority people, particularly if it involves alcohol consumption (CABE, 2005), as is generally the case here, even though some BME religions' bar this in its entirety.

Although much has changed, the drinking culture and coarse language that remain common in the construction workforce still amplify feelings of difference and of being 'other' among those who do not and will never, because of colour or gender, share such a culture (Caplan and Gilham, 2005). Ethnic minority members of staff may also be assumed to be hypersensitive should they complain about such issues (CABE, 2005), yet oversensitivity more often stems from white managers concerned about possible accusations of racism and potential legal consequences (ConstructionSkills, 2007).

Despite public commitment on the part of sections of the industry towards equality and intolerance of racism, including racist 'jokes' and banter, the latter continue to be part and parcel of the culture of the construction industry (Royal Holloway, 1999; CABE, 2005). One study highlighted that ethnic minority staff are usually unaware of the rights that protect them from racial or religious harassment in the workplace (ConstructionSkills, 2007) and as a result resign to tolerating racial banter or avoid it altogether by leaving the industry (CABE, 2005). Stopping casual racism has been noted to stem usually from individual intervention by managers, colleagues or friends rather than company policy.

Lessons learned here are that the fragmentation of the UK construction sector has many trades, small businesses and different, numerous roles which make it difficult to be monitored for good practice compared with other Western European counterparts Byrne et al, (2005). A recent television programme namely, 'Cowboy Builder' is a pointer to this fact where contracts resulting in shoddy work and uncompleted projects, especially of house repairs for vulnerable landlords have gone unmonitored only to be checked through a television team. If such grotesque acts, visible and measurable in space and time, go unpunished, at least for considerable lengths of time, the scale of the difficulty in monitoring the many trades and their cultural practices and numerous ways of doing things especially, as this relates to employment issues is somewhat evident.

### **Language**

Language, a word derived from the Latin word *lingua*, is a system of symbols for encoding and decoding information (Wikipedia). Probably, the correlation between culture and language even precede classical civilization as the ancient Greeks, for example distinguished between civilized peoples and Barbarians - *Bárbaros* meaning "those who babble", literally translated as those who speak unintelligible languages (Baepler, 2003). The many different unintelligible languages spoken by different societies have been an underlying basis for cultural differences compared with other less obvious cultural traits. A direct connection between culture and language has been established by some German romanticists of the 19th century such as Herder, who saw language not just as one cultural trait among many but rather as the direct expression of a people's national character (Anderson, 1983).

Consequently, the majority of BME people arrive in the host countries with languages and national characters other than what is in local usage while hoping to be able to communicate at a level comparable to their host nations' counterparts. This does not only pose a challenge, but also affects the way their employers and colleagues on a job react to them. Language has therefore been seen as a major barrier to the uptake of BMEs in the industry (Ahmed, et al, 2008; Cabinet Office Strategy, 2007; Construction Skills Network, 2007; DTI 2007; Gale A. and Davidson, M.J. 2006; CABE, 2005). In their neighbourhoods, immigrants tend to rely on their native

language since many of them live separately from the host society. They therefore communicate more with their mother tongue in everyday life and as a result, tend to be isolated because other people fail to understand them.

In this regard, education and training of human capital defined as a sum of educational qualifications; skills, knowledge and experiences of a person which acts as a main determinant of labour market outcomes is brought to bear as Ethnic minority groups with significant variations in terms of education and training. On average, Indians, for example have higher levels of literacy, numeracy and skills than their White counterparts. In Ahmed, et al (2008), it was found that the average level of educational achievement of ethnic minorities exceeds the adult national learning achievements of the British White cohort. However, some groups of Pakistani and Bangladeshi backgrounds on average experience lower levels of educational attainment. For example, 37 percent of these ethnic groupings are at level 3 in the national qualification framework (the equivalent of two or more A-levels) compared with 46 percent of their White counterparts (Shield and Price, 2003). Although, a greater number of ethnic minorities face difficulties in English language which affects their social and economic integration it has however been found that immigrants who speak fluent English earn about 20 per cent more income (ibid).

Language is also an important driver of social capital which according to Colman (1988) is importance to the family and its children's educational outcomes. In fact, Platt (2005a) stresses the direct correlation between the success of future generations and their family characteristics which has also been confirmed by Amato (1998). Additionally, Colman (1998) stressed in this regard that the social capital of the family can be measured in terms of the strength of the relation between parents and children. This, of course, depends upon the physical pressure of adults in the family and on the attention given by the adults to the child. For example, Colman found that the family network has an important effect on the likelihood of children to drop out of school and all this is influenced by their communication skills based on the strength of language.

Elsewhere in Norway, a study of ethnic minorities identified the important role social networks play in the integration of these groups in the labour market. The results of this study found that time spent in the labour market for ethnic minorities is essential for their earnings rate and level of unemployment (Brekke, 2002). According to Borjas (1995) there is a growing appreciation of the potential influence that the social and economic environment of the country (in general) and household (in particular) has upon socio-economic outcomes. The existence of social capital and other forms of neighbourhood effects has crucial implications for a wide array of policy issues such as the creation and growth of a social underclass, including language and cultural persistence.

Moreover, another study by Herrington and Herrington (2004) in Switzerland on the transition from education to employment found that the social and economic background of parents has an impact on this process. For example, the educational level and occupational status of the parents at the date of the degree of their son/daughter are both significant in influencing them from obtaining employment. This means that a graduate has a higher probability of getting a job if at least one parent is in employment. Again, it was found that the graduates who have previous working experience are more likely to obtain a job than new graduates. In another study about Spain and Belgium, Kalter and Kogan (2006) measured the highest level of educational attainment of parents. They found that there were similarities between

the indigenous population and youths from the EU in Belgium in terms of their highest level of education. While in Spain, the study found that the parents of immigrants from the EU states were more likely to be educated in comparison to the parents of the indigenous people, it was however found, in both countries, that the vast majority of Moroccan parents had only secondary education. It was also found that the social background of other non-EU immigrants were comparable to the social background of indigenous population.

### **Religion**

Again, like language in the preceding section, religion also has a direct correlation with culture. Among several definitions of religion, the online dictionary.com offers a more comprehensive one as a set of beliefs concerning the cause, nature, and purpose of the universe, especially when considered as the creation of a supernatural agency or agencies, usually involving devotional and ritual observances, and often containing a moral code governing the conduct of human affairs. Religion has been known to pose as a disadvantage as a particular group's faith or religious characteristics affect their performance in the labour market due to values or practices that affect their interaction with their host. Anecdotal evidence indicate that religious attributes strongly influence the labour market position of ethnic minorities, generally, yet according to the Fourth National Survey of Ethnic Minorities (FNSEM) in quantitative data in this field was limited. The most robust data set available in this area is the differences by religion in the share of the economically active population in paid work. They show that Muslim men and women were least likely to be in paid work, whilst Hindus were the most likely. Alternatively, disadvantages may be faced by a faith group due to the presence of prejudice and stereotypes that may exist about that faith group and may reflect people's negative attitudes towards that group. A combination of these factors may exist where Muslims are concerned and may in part explain their low levels of labour participation which may be identified as the 'Muslim Penalty' (Cabinet Office Strategy Unit, 2003).

However the relationship between religious groups and employment outcomes are not simple. Despite overall high Muslim unemployment rates, Indian Muslims have higher employment rates than Sikh men a reason for which religion has been said to be simply a proxy for other factors determining employment, like education and fluency. However, it has been found that the odds of being unemployed do vary significantly with religion (Brown, 2000). Even after controlling for a range of factors, Sikhs and Indians Muslims remain almost twice as likely to be unemployed as Hindus and Pakistani Muslims are more than three times as likely to be unemployed (ibid).

Looking at employment profiles and income differentials, there is also evidence of different experiences between religious groups as has been indicated by the Cabinet Office Strategy Unit, (2003). According to them, Sikhs, Pakistani and Bangladeshi Muslims show particular under-representation in professional employment, with this area showing higher concentrations of Hindus and Indian Muslims. In terms of earnings, Muslim men and women are overrepresented in the lowest income band. Almost a quarter earned less than £115 per week, compared to around one in ten Sikhs and Hindus. Yet despite over-representation among low earners, Indian Muslims actually record the highest share within the highest income band. Judging whether religion is a factor that affects the employment chances of a given individual is complex. Although differences between the outcomes experienced by religious groups

can be demonstrated, it is impossible to show causality. It is clear that Indian Muslims are strikingly different from South Asian Muslims in their achievement rates, suggesting that far more is at play than just religious effects. Moreover, significant signs of change for the young (second- and third-generations) are not apparent, indicating that the problems might well be more linked to specific group circumstances for which religion is a proxy, rather than religion itself.

Additionally, a study of construction in the North West of England found that ethnic minority people, particularly those of Asian or Muslim heritage, were seen as the representatives of their community suggesting that being Asian and Muslim forms the biggest potential barrier to acceptance by British society (Ahmed et al, 2008). Other evidence indicates that Asian Muslims find it difficult to discuss religion or religious practices such as fasting or some news items such as the Iraq or Afghan Wars or terrorist incidents without attracting criticism (ConstructionSkills, 2007). Ethnic minority managers often feel the intense pressure of scrutiny not to be seen to show preference to their own ethnic minority colleagues (Caplan and Gilham, 2007).

In effect, religion and religious practices have been an underlying divisive force in many instances as discussed above and this has resulted in the host nations reacting in a hostile manner towards, Muslims, for example. The recent attempts to attribute terrorism with Muslims after the bombings in the US and the UK have worsened the ill feelings, a situation which requires the understanding of the religion concerned. Earnings also seem to have a direct correlation with religion these are but a few of the factors that server rather as disincentive to the attraction of BMEs into the industries where such practices are a norm.

## **FINDINGS AND CONCLUSIONS**

Based on the aspects considered above through investigating the necessary literature, the findings that emerge give an overall picture of a vital industry bridled with acute shortage of skills, yet refusing to engage the group with a more sustained younger population and perpetuating similar business and procurement practices unlikely to widen the pool of labour. As a result, BMEs face limited opportunities in an industry that is not acting favourably enough to encourage them to enter it and progress. This under-representation is even worse in managerial and professional roles notwithstanding, the relatively high take-up of education and training courses in the industry by BME groups which, on balance, points to an interest from that section of the population.

This situation is worsened by the prevalence of word-of-mouth recruitment and tendering practices which creates low levels of awareness within BME communities of the wide range of opportunities in construction as there is a lack of informal information networks within BME communities about work in the construction industry. Again, persistent perceptions of racism, the lack of implementation and monitoring of equal opportunities policies and diversity management makes it even less plausible for the BME to compete for jobs in construction. Furthermore, in the UK, for example, the fragmentation of the construction sector has resulted in creating many trades, small businesses and different, numerous roles which make it difficult to be monitored for good practice compared with other European counterparts.

Also, the resultant transformation from the various stages of an entrant into new culture can be enormous. These processes will vary as with cultural measurements, some originating cultures have characteristics similar to the host's and so are easily



adaptable. Notwithstanding, the need to recognize difference and respect a multicultural coexistence remains the key to ensuring a fair representation of minorities. This process of multiculturalism is suitable for building a cohesive group that is capable of working as teams on construction projects.

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# THE EFFECT OF RESTRUCTURING THE CENTRAL BUSINESS DISTRICT (CBD) ON URBAN HOUSING AND POVERTY IN LAGOS, NIGERIA

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Lagos is currently undergoing significant urban renewal and this has the potential to affect more than 80% of its estimated 15million population. The purpose of this research is to examine recent developments in the Central Business District (CBD) infrastructure and services in the Lagos State restructuring programme with its adverse effects on urban fabric; the four key elements of urban life: employment, housing, transportation and the environment. With the on-going revitalization project coupled with global recession, inflation and lack of welfare system the urban poor have felt the harsh conditions more. Study site is the city centres like Lagos-Island (CBD), Lagos mainland (CBD), Victoria-Island (CBD) and Lagos Capital Ikeja (CBD). The Singapore experience in urban regeneration is taken as case study. Questionnaires will be administered to displaced residents and the main actors that carried out the past and present schemes from 1980 to 2008. Method of analytical generalization and other evidence employed in processing the architectural physiognomy and CBD imageability that emanates from the fusion of 5E+3C=I (imageability, legibility). The use of historical documents, literature reviews, cartography, urban design theory. Geographic information system (GIS) will also be employed. The research results will provide a data base for policy formulation and implementation for effective environmental and metropolitan development in Lagos.

Keywords: CBD, displaced resident, Lagos, metropolitan area, urban-poor.

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# THE EFFECTS OF MANAGEMENT ON PRODUCTIVITY: A COMPARATIVE STUDY OF INDIGENOUS AND FOREIGN FIRMS IN THE NIGERIAN CONSTRUCTION INDUSTRY

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The productivity of the Nigerian construction industry is significantly lower than those of its foreign counterparts. Research results indicate that the Nigerian construction industry is plagued by inefficient policies and practices, weak institutions and adverse business environment, complicated by complex social and cultural practices, which makes it difficult for the indigenous contractor to perform efficiently. The same study identified poor contract management as the second most important structural problem. This work undertakes a comparative appraisal of the effects of certain management policies and actions on the productivity of construction workers by both indigenous and foreign contractors working in the Nigerian Construction industry. Through a survey, a set of those management's actions relating to workers and working conditions were identified, analyzed and their effects on the performance of contractors to determine what gave the foreign contractors the competitive advantage were reviewed. The emphasis of foreign contractors on training/competence, pre-construction planning and use of construction equipment stood out as the most important competitive advantages over the indigenous contractors. However, there is a general lack of incentive and low morale within the workforce and a perception that their self improvement is not important to their employers.

Keywords: contractor, competitive advantage, pre-construction planning, productivity, management staff, Nigeria.

## INTRODUCTION

The productivity of the Nigerian construction industry has been found to be significantly lower than that of their foreign counter-parts resulting in a major percentage of the total projects in Nigeria going to foreign contractors (Kirmani 1988). The poor performance of the indigenous contractors in Nigeria has been the subject of many past works; (Wahab 1977, Edmunds and Miles 1983; Okpala and Aniekwu 1987, Aniekwu and Okpala 1988, Aniekwu and Okpala 1989, Aniekwu 1995, Aibinu, and Jagboro 2002, Aniekwu and Nwachukwu, 2002, Aibinu, and Odeyinka, 2006). Although construction accounts for a substantial percentage of the GNP in Nigeria and constitute almost half of the total public spending, the indigenous construction industry is slow to benefit from this trend, often losing even routine projects as low rise housing to foreign contractors (Adeyemi, 2000). A construction

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industry that executes highly complex operations using expatriate personnel and imported technology and materials, may be able to achieve high qualities of construction, but the value added to construction and the local industries supplying construction inputs will be low. Developing countries need to optimize the values added in the construction industry in order to enhance the efficiency of this investment (Kirmani S, 1988).

Productivity can be defined as the relationship between inputs and outputs of a production system, which is a process of converting resource (inputs) into goods and services (outputs) (Schroeder, 1989). If more output is produced with the same input, productivity is improved as well as if fewer inputs are used for the same output. Thus, whatever affects the output-input relationship affects productivity. In operations, productivity is affected by all decisions, including the process design, capacity, inventory, workforce, and quality of decisions (Schroeder, 1989). There is a distinct need for control, direction and coordination of activities in any human endeavor which gives a sense of order and organization if there is the involvement of different parties and diverse systems in the enterprise. The aim is to annex and integrate these differences into a single purpose, geared towards the accomplishment of the objectives of the enterprise. Whether in intangible or intangible terms, every enterprise has a goal - an overriding objective – the accomplishment or otherwise of which determines how productive the endeavor has been. Thus, there is a direct relationship between the management of an enterprise and the level of productivity of that enterprise.

Management in performing its functions makes policies and decisions in order to optimally manage the diverse resources at her disposal towards the attainment of the enterprise objectives. These decisions impact directly on the performance of the workers and the working conditions. In some cases, such actions improve workers performance and in some, hamper them. Hence, management has to contend with the motivation of workers as well as strive to enhance and maintain an enabling work environment, since workers productivity depends on an enabling work environment.

Nigeria's poor human resource base which has resulted in poor management practices is considered to be her biggest handicap in attracting foreign capital, improving productivity and reducing poverty (Economic Commission for Africa, 2002). Poor contract management was identified as the second most important structural variable causing delays and cost over runs. This is obviously a consequence of the lack of necessary knowledge and skills which has been reviewed by Okpala and Aniekwu (1987) and is endemic in most developing countries. When the productivity of the Nigerian construction industry is compared to that of its foreign counterpart (either Nigerian branch of a foreign company or Nigeria/Foreign joint venture) within the Nigerian construction industry it is low. However, since both foreign and local contractors work under the same environment and draw from the same labour pool, it is important to understand the source of the competitive advantage of foreign contractors. This has created the impetus for this study

## **RESEARCH METHOD**

Construction processes are heavily dependent on labour utilization. Clearly, the productivity index of the industry in Nigeria is majorly a reflection of the state of management of the labour force. In determining the issues concerning the workforce as management functions, Lockyer (1974) identified the aspects of production relating to people (human resource) as: (1) Wages, (2) Safety, (3) Working conditions, (4) Motivation, (5) Trade unions, (6) Education and training. These were advanced as

areas management should properly address for productive management of the workforce. Furthermore, Schroeder (1989) highlighted areas of management decisions relating to workforce management as: (1) Job design, (2) Staffing levels, (3) Selection, (4) Training and career development, (5) Appraisal.

A questionnaire was designed incorporating variables addressing these aspects of workforce management identified above. The questionnaire used a five-point Likert-type scale to measure a range of opinions from “Very weak” to “Very strong”, “Very low” to “Very high”, etc. as the case may be. The significant agreement or otherwise with the notion being tested was determined by adopting the mid-point value of the index (that is 3) as the hypothesized mean (Coakes and Steed, 2001). This implies that any result significantly different from this uncommitted or unsure value was assumed to be either positive or negative to the notion being tested (Pullin and Haidar, 2003).

The questionnaire was in two sections. The first, designed for field workers included 43 variables and the second section addressed the management staff and included 37 variables. They were distributed to contractors operating in Akwa Ibom State, Rivers State, Lagos State and Delta State. The States all fall within the Southern part of Nigeria which are the most active construction towns in Nigeria and between them contain all the Sea ports and Oil fields in Nigeria. A total number of 434 questionnaires were distributed to construction companies randomly chosen to ensure a confidence level of at least 99% in accordance with the recommendations of Rea and Parker (1997). There were 296 respondents, representing a response rate of 68.2% (Table 1). This response rate is considered adequate (Idrus and Newman, 2002).

Table 1. Summary of questionnaires distribution and responses

City	Number distributed	Number Returned (Field Workers)	Number Returned (Management)	Overall % of response
Lagos	174	154	120	78.74
Port-Harcourt and Uyo	100	41	45	43
Warri	80	50	50	62.50
Asaba	80	71	61	82.50
Total	434	316	276	68.20

## ANALYSIS OF RESULT

The analytical procedure employed was aimed at establishing the relative importance of the variables in affecting the conduct of work based on how the workers perceived them. In the analysis, weights were assigned to different degrees of seriousness or importance attached to the variables. The sum total of points obtained based on the responses on that variable is used to determine its severity index which is defined below.

$$SI = \frac{\sum_{w=1}^5 R_w W}{R_t} \quad \dots \quad \dots \quad \dots \quad \text{Equation (1)}$$

Where  $R_w$  = No of respondents

$W$  = weight or point assigned

$R_t$  = Total number of response obtained for that variable.

Table 2. General ranking and severity indices of field workers responses

Rank	Variables	Question Number	Severity Index
1	I need frequent technical exposure/training.	1AO	4.13
1	I am technically competent for the work I do.	1AN	4.13
3	Materials supplies are adequate.	1X	3.94
3	The firm is properly organized.	1B	3.94
5	Provisions for first aid are adequate.	1E	3.88
6	If I have the opportunity I will rather work for another company.	1AM	3.85
7	Salaries are promptly paid.	1Q	3.82
8	The targets of work are generally satisfactory.	1F	3.81
9	The company cherishes good human relationship.	1Z	3.77
10	Management ensure clean working environment.	1AP	3.75
11	Construction equipment and plants are fully utilized.	1Y	3.68
12	Management expectations of workers are too high.	1S	3.65
13	The workers social/religious beliefs are respected.	1R	3.62
14	Job supervision is satisfactory.	1J	3.59
15	My firm is the best in the industry	1A	3.53
16	Site conditions are generally safe.	1U	3.51
17	I am overworked.	1AF	3.50
18	The workers interest is inconsistent with the interest of management.	1I	3.45
19	The company's welfare package is good.	1C	3.44
20	The method of remuneration is adequate.	1P	3.39
21	My duties involve high risks.	1AE	3.36
22	I am provided with sufficient safety clothing.	1V	3.31
23	Management treats me like a human being.	1AJ	3.30
24	Bosses accommodate creative suggestions.	1AI	3.27
24	There is room for self improvement.	1AK	3.27
26	Supervisors have favorites.	1K	3.24
27	Wages and salaries are commensurate with work done.	1AH	3.21
28	Construction equipment and plants are properly maintained.	1W	3.20
29.	Most workers are sycophants.	1L	3.17
30.	The work targets are too high.	1AD	3.16
30.	Workers enjoy good inter-personal relationship.	1AC	3.16
32.	Creativity is encouraged.	1H	3.15
33.	Supervisors' instructions are usually ambiguous.	1M	3.10
34.	Management takes workers for a ride	1AB	3.04
34.	Transportation arrangements are adequate.	1AL	3.04
36.	Site instructions often conflict.	1D	3.01
37.	The company has a Christian orientation	1AQ	2.92
38.	There is often conflict of interest amongst management staff.	1O	2.91
39.	Management treats me as mere tools.	1AG	2.79
40.	I am adequately insured against such risks.	1T	2.72
41.	Arrangements for feeding during break periods are adequate.	1G	2.66
42.	The company is interested in our future.	1AA	2.53
43	Wages and salaries are comparably better than those in other firms.	1N	2.30

In order to measure the level of agreement in ranking between groups of respondents, a rank agreement factor as defined by Okpala and Aniekwu, (1987), and given in equation (2), was used for any two groups. The percentage disagreement  $P_d$  represents the average absolute difference in rank of the item;

$$P_d = 100 \times \frac{\sum_{i=1}^N (R_{i1} - R_{i2})}{\sum_{i=1}^N (R_{i1} + R_{i2})} \quad \text{Equation (2)}$$

Where  $N$  = number of items.

$$i = 1, 2, 3, \dots, N.$$

$$j = N - i + 1.$$

while percentage agreement  $P_a$  is

$$P_a = 100 - P_d \quad \dots \quad \dots \quad \dots \quad \text{Equation (3)}$$

A detailed analysis of the responses based on different grouping of respondents, and the general result was carried out and the result based on the general sample is given in (Table 2).

Spearman's rho and Kendall's tau-*b* rank-order correlation coefficients indicating the extent of agreement between the rankings of the factors by local and foreign contractors was also applied. No statistically significant agreement (at 0.05 level of significance) in ranking was found between the groups.

A total of 296 responses was received, made up of 223 indigenous contractors (wholly Nigerian owned) representing 75% of the total responses and 73 foreign contractors (either Nigerian branch of a foreign company or Nigeria/Foreign joint venture), representing 25% of the respondents. The large difference in the 2 categories of responses may suggest a possible bias towards indigenous contractors, however a percentage agreement of 78.5% was recorded, which imply that both groups agree and do indeed face similar problems. From the investigation, out of the 296 respondents to the enquiry, 45 of them (15%) were classified as large scale contractors i.e. with an annual turnover of over ₦5.0 million. 135 or 46% were classified as medium scale contractors, with annual turnover of between ₦1.0 million – ₦5.0 million, while 115 or 39% were classified as small scale contractors with annual turnover of less than ₦1.0 million (\$1.00 = ₦145). Within the large scale category, 79% are foreign contractors and this represents 78% of all the foreign contractors and only 12% of all that responded to the enquiry. However the total income of this 12% far exceeded the combined income of the rest of the industry.

## DISCUSSION OF RESULT

Analysis of the results were based on different categories of respondents and a general analysis, since the severity index obtained for each variable differed for the different groups examined. The respondents were analyzed based on;

Location of respondent (State of respondent),

Structure of Ownership of respondents companies (Foreign or indigenous).

The size of the company (small, medium or large),

Number of years of operation of respondents' companies.

For field workers (for ages < 20years and ≥ 20 years).

For management staffs (for ages < 20years and ≥ 20years).

Companies which provide insurance and safety for its workers.

- For field workers (insurance and safety provisions < 50% and ≥ 50%).

- For management staffs (insurance and safety provisions < 50% and ≥ 50%).

As a result of the limitations imposed by a Conference publication, we cannot discuss the entire work rather, our focus shall be the ownership structure of the respondents companies, i.e. indigenous and foreign contractors and will only discuss the top and bottom two variables of the general rankings by both field workers and management staff of both indigenous and foreign contractors operating in the Nigerian construction industry.

Table 3. General ranking and severity indices of management staffs response

Rank	Variables	Question Number	Severity Index
1.	Our company performance is satisfactory.	2A	4.02
1.	All our sites are well organized.	2X	4.02
3.	Weather conditions affect our site functions.	2AJ	3.93
4.	Safety and accident free operation is very important to the company.	2AE	3.87
5.	We value clean work environment	2AD	3.85
6.	The firm is properly organized.	2B	3.82
7.	Our policies/instructions are clear and precise.	2M	3.79
8.	Ours workers are treated satisfactorily.	2D	3.75
9.	We have good, 'esprit de corps'.	2N	3.74
10.	We have always met our targets.	2C	3.68
11.	We have a good information feedback.	2G	3.66
11.	Utilization of construction equipment and plants/machines are ensured for all works	2Y	3.66
13.	We maintain good human relations.	2L	3.60
14.	We discuss freely with workers.	2F	3.58
15.	Political and environmental factors affect our productivity.	2AK	3.54
16.	The company gets value for its money.	2Z	3.48
17.	We have no problems with raw materials.	2W	3.39
18.	The company really makes you grow.	2AH	3.28
19.	Our only choice is to be here presently.	2U	3.27
20.	Government policies adversely affect our policies and actions.	2AI	3.25
21.	Our wages are one of the best in the industry.	2J	3.21
22.	All complaints are treated with dispatch.	2AG	3.19
23.	Our maintenance division is excellent.	2AB	3.17
24.	We have the best feeding arrangement in the area.	2I	3.14
25.	Our workers have no reason to complain.	2K	3.06
26.	We can boast of the lowest wastage levels in the industry.	2AA	2.93
27.	Workers are always difficult.	2E	2.79
28.	Some of our bosses are too bossy.	2O	2.70
29.	Our workers cannot have it so well in any other company.	2AC	2.06
30.	Some managers have stolen the show.	2Q	1.75
31.	It is difficult for the managers to arrive at an agreement	2P	1.69
31.	Individual creativity is stifled by management methods.	2R	1.69
33.	We are just working for the big boss.	2S	1.63
34.	We are comparably poorly paid.	2V	1.56
35.	Management does not accommodate suggestions.	2H	1.38
35.	There is no room for self improvement.	2T	1.38
37.	The workers cannot complain of anything.	2AF	1.31

#### FIELD WORKERS (TOP RANKINGS)

1. I need frequent technical exposure/training. (SI = 4.13)
2. I am technically competent for the work I do. (SI = 4.13)

#### FIELD WORKERS (BOTTOM RANKING)

1. Wages and salaries are comparably better than those in other firms. (SI = 2.30)
2. The company is interested in our future. (SI = 2.53)

#### MANAGEMENT STAFFS (TOP RANKING)

1. Our company's performance is satisfactory. (SI = 4.02)

2. All our sites are well organized. (SI = 4.02)

#### MANAGEMENT STAFFS (BOTTOM RANKING)

1. The workers cannot complain of anything. (SI = 1.31)

2. There is no room for self improvement. (SI = 1.38)

#### (a) FIELD WORKERS

*“The need for frequent training and exposure”*, and *I am technically competent in the work I do*”, were both ranked 1<sup>st</sup> by all field respondents with a severity index of 4.13. Foreign companies ranked the need for frequent technical exposure/ training (1AO) 1<sup>st</sup> with a severity index of 4.32, while indigenous firms ranked it 2<sup>nd</sup> with SI = 3.93. This indicates a strong agreement on the subject of training for the workforce and the importance they attach to improving their individual performance and the general productivity.

*“I am technically competent for the work I do”* was ranked 1<sup>st</sup> with a severity index of 4.13 by the general analysis, ranked 1<sup>st</sup> with a severity index of 4.14 by the indigenous field workers, while it was ranked 5<sup>th</sup>, with a severity index of 4.12 by foreign indigenous field workers. There is a correlation between the 2 variables and will thus be discussed together.

The strong agreement on the subject of training for the workforce and the importance they attach to improving their individual competence, performance and the general productivity clearly identifies the main area of competitive advantage of the foreign contractors over indigenous contractors. Indigenous firms perceive this variable as most important because they are not exposed to the use of new methods and equipment as much as their counterparts in foreign firms.

Research results indicates that although the majority of workers in the Nigerian construction industry do not receive adequate training, the need for training of construction workers is either not fully appreciated or is not considered important enough to receive the kind of attention it deserves (Hartnett, 2000, Dabalén and Bankale, 2000). The facilities for conducting training are grossly inadequate even if the need is appreciated. For these and a host of other reasons most contractors do not have formal training in the area they operate. Most of them begin as trade apprentices and artisans and go on to become foremen and eventually gain enough confidence to venture into contracting. Their training is therefore gained from the experiences gained on the job. Some inherit a construction enterprise from the family or take up construction contracting after working within the construction industry as engineers, suppliers etc. Others become contractors when they find themselves in the positions to secure construction contract through contacts. In such cases often the contract is received before the company is setup. How long such contractors survive is based on too many factors. While some fail early, others give up when the risks become unacceptable, while some advance to higher levels of growth. There are many who did not receive formal training but are able to hire the required skills and have achieved remarkable successes (Aniekwu and Osedeme, 2004). The fact that the workers claim to be technically competent for the work they do and at the same time stress the need for their frequent training and exposure is very typical of the paradoxes that abound in the Nigerian business environment and psych which result from insecurities and instabilities in the system. While the workers fully realize their self inadequacies in the work they do, they are wont to reject any suggestion of such deficiencies for fear that they may be retrenched on that account.

However given the complex nature of the construction industry, the need for skilled workers and the need for the contractor to continuously upgrade their knowledge and enhance their ability to cope with problems is an absolute necessity of any contemporary construction industry (Aniekwu, 2006). This seems to be part of what the foreign contractors do better than the local contractor which gives them competitive advantage.

*The adequacy of materials supply (1X)* is ranked 2<sup>nd</sup> by foreign firms (4.31) and 10<sup>th</sup> by indigenous firms (3.56). The level of importance attached to it by foreign companies indicates the extent to which they go to procure all necessary materials required prior to their operations.

*The variable relating to the full utilization of construction equipment and plants (1Y)* is ranked 3<sup>rd</sup> by foreign firms (4.19) and 21<sup>st</sup> by indigenous firms (3.23). The clear deviation in ranking is a reflection of the actual situation. Foreign firms utilize equipment and plants more, because they have greater knowledge and awareness of modern construction methods requiring plants and equipment. Thus most indigenous firms rely on traditional labour intensive, not so efficient, methods of construction or at best use outdated equipment. These variables give indications of the areas of divergence between in the indigenous and foreign contractors, which may account for the competitive advantage of the foreign contractors over indigenous contractors.

*1 Wages and salaries are comparably better than those in other firms (1N): ranked 43<sup>rd</sup> (least) by both foreign (2.76) and indigenous (1.86) firms.*

*2. The company is interested in our future. (SI = 2.53)*

The two variables above are the lowest ranked variables by field workers. The low ranking by both foreign and indigenous firms underscore the agreement on the low importance attached to them. Both variables are also related to workers welfare and have the capacity to affect the morale of the workmen. Not only are salaries low, the job security is absent. Although there are provisions for the payment of fair rates of wages and the observation of conditions of employment not less favourable than those established by the ministry of trade and industry, conditions in most developing countries are such that these regulations are rarely enforced. Also given that despite an acute shortage of skills, there is a high rate of unemployment. The effect of this is that too many workmen are seeking limited work places, which limit their ability to negotiate or insist on compliance with the provisions of the conditions of their engagement (FIDIC, 1977), (GC/Works/1, 1973) (ICE, 1973, 1991), (RIBA, 1963, 1980).

There are other provisions which allows for the freedom of the work people to be members of trade unions (a body through which they can seek compliance with the provisions of the conditions of their engagement). The effect and aim of these provisions are lost in most developing countries because contractors do not employ permanent workers, instead they rely on daily paid workers who can be engaged and discharged without complications as the job needs fluctuate. Consequently, it is difficult for work people to organize into unions because they hardly stay in one employment long enough and also are too busy trying to keep their jobs.

The provisions for insurance and other workers welfare related provisions are similarly ineffective owing to the nature of the business environment in Nigeria. The net implication is that workers have very little commitment to their employers and the



morale is very low since they perceive that the employer sees them as mere tools for his operations.

(b) MANAGEMENT STAFF:

1. *Our company's performance is satisfactory. (SI = 4.02)*

2. *All our sites are well organized. (SI = 4.02)*

The variable, “*Our company's performance is satisfactory*” and *All sites are well organized*” (2X), was ranked 1<sup>st</sup> by the general ranking with a severity index of 4.02. It was ranked 1<sup>st</sup> by foreign firms (4.40) and third by indigenous firms (3.74). The high ranking of the variables by both categories of companies is indicative of the satisfaction of the contractors with the state of things. The satisfactory performance does not imply the absence of inadequacies or difficulties rather the ability to manage the constraints associated with construction in Nigeria effectively. It is true that profit margins are extremely high in the Nigerian construction industry; often entire projects are fully paid for and not executed. The (Nigerian national Petroleum Company (NNPC) in 2002, through its joint venture partners awarded a contract worth \$1 billion to Halliburton for about \$3 billion (Chinedu, 2006). The Abuja national stadium built at an over-invoiced cost of \$360million by a German construction firm (Bilfinger and Berger) is also a case in point.

Previous survey (Charles Kenny, 2007) evidence suggests the diversity of types of corruption present in the sector – from bribes designed to manipulate budgeting decisions, project selection, tender specifications, procurement outcomes or contract negotiations and renegotiations, through bribes designed to cover poor quality construction practices and outcomes, to the theft of materials. Thus the level of professionalism required of the contractors and the degree of supervision they are subjected to are very easily compromised. The contractor can practically do anything he wants as long as he bribes effectively and contract provision especially with respect to workers welfare and social corporate responsibility are totally ignored without consequence.

1. *The workers cannot complain of anything. (SI = 1.31)*

2. *There is no room for self improvement. (SI = 1.38)*

The ranking of these two variables as being of the least importance to both foreign and indigenous contractors reflect a common position in approach to matters relating to workers welfare. It indeed reflects the level of intransigence by the contractors with respect to workers welfare. While the workers are being stifled and denied every right, the employers feel they are doing just fine as long as the profit margins are good. As mentioned earlier, the contractors are quite satisfied with the status-quo as long as they are able to receive high profit margins and feel that there is no need for any changes.

Transparency International's 15 country poll ranked construction as the most corrupt industry. Because the industry involves complex, non-standard production processes that foster asymmetric information stocks between clients and providers, and because of its many close ties to government, it is perhaps unsurprising that construction is frequently held up as one of the most corrupt industries worldwide. The contracted work does not necessarily have to be done to receive payment and as long as this is possible, given Nigeria's weak institutional infrastructure, the contractors do not care

about the workers opinion nor do they care for the status-quo to change even when it is killing the industry.

## CONCLUSION

The attention of foreign contractors to some critical areas of construction such as training, pre-construction planning and the application of modern construction techniques account for the competitive advantage they have over indigenous contractors. Although they operate in the same environment and draw from the same pool of labour they perform better than their Nigerian Counterparts. So much so that indigenous contractors loose out even on routine construction projects such as housing to their foreign counterparts which is not in the interest of the development of the industry. If the indigenous contractors must compete effectively in the Nigerian construction industry, then she will need to adopt some of the practices of their foreign counterparts, especially those practices that are very prominent in giving them a competitive advantage.

The effects of corruption which affects most spheres of construction practice and ensure a healthy profit margin for the contractor, whether he works or not is endemic and clearly apparent in the system. Because of construction's central role in development, corruption in the sector can be especially harmful. In particular, corruption that leads to poor quality construction or which supports an environment of poor project selection and insufficient maintenance can significantly reduce the economic return to investments, and carry high human costs in terms of injury and death.

Clearly, the feeling of exploitation by workers and the understanding that they are mere tools in achieving the Company's objectives does not add to their commitment in seeking to improve productivity. This situation will not build workers confidence in the Management of the firms. Increased workers participation and willingness to contribute to the improvement of the industry will annul the impression that "Management treats workers as mere tools".

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# THE EVOLUTION OF INDIGENOUS CONTRACTORS IN GHANA

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This paper provides some preliminary insights into the emergence and development of indigenous general contractors in Ghana. General contracting is the means by which an individual or organisation takes responsibility for supplying all of the materials, labour, equipment and services necessary for the construction of a project. Whereas the development of general contracting in places like the UK is well documented, the evolution of contractors in Ghana is not clearly articulated in the literature. Therefore, the main question in this paper is: How did indigenous contractors evolve in Ghana? To examine and analyze the research question, a literature review on similar developments elsewhere was first carried out. This was followed by discussions and unstructured interviews with experienced construction practitioners in Ghana most of whom were Quantity Surveyors. Most interviewees narrated their knowledge of contractor development in Ghana dating back to around 1945. From the explanations given, it was possible to develop a general understanding of the research question and to make a qualitative interpretation of the respondents' comments and to draw some conclusions. General contractors emerged rapidly in the Gold Coast (now Ghana) shortly after World War II. Most were Italian master craftsmen in Ghana who were capitalized by the British colonial government to develop infrastructure in the Gold Coast following devastating effects of the war. Some of the indigenous people learned from the Italians and also established construction firms. Thus, general contracting in Ghana has a relatively short history in comparison to countries like Britain where the profession developed rapidly in the early part of the 19<sup>th</sup> century in response to the industrial revolution. Although they may possess sufficient technical expertise, many indigenous contractors in Ghana today lack the capacity to carry out major projects because of low capitalization and poor organisational structures. The current construction market in Ghana is dominated by foreign contractors. To become major players in the market, indigenous Ghanaian contractors should build strong organisational structures and pursue mergers and joint venturing to boost their financial, technical and managerial capacity.

Keywords: contractor, general contracting, Ghana.

## INTRODUCTION

The purpose of this paper is to provide preliminary insights into the emergence and development of general contracting in Ghana. General contracting is described in most part of the literature in construction management as the means by which a firm or individual takes responsibility for supplying all of the materials, labour, equipment and services necessary for the construction of a project (as explained in a standard construction contracts textbook by Murdoch and Hughes, 2008: 27-9). Whereas the

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evolution and development of general contractors in countries like the UK is well documented in studies like a historical overview of technological change in the construction industry by Hughes and Hillebrandt (2003) and a historical overview of construction in Britain by Winch (2000), the evolution of general contractors in Ghana is not a subject that is articulated in the literature. Therefore, the main question in this paper is: How did general contractors evolve in Ghana? This paper aims at addressing that question by providing some initial ideas that can be developed further through future research. This will help to position general contracting in Ghana in the context of general contracting in a wider and international sense. Local or indigenous construction firms are those established and owned by locals and citizens of a country whereas foreign firms are owned by foreign nationals. In order to examine and analyze the research question on the evolution of general contractors in Ghana, a literature review on similar developments elsewhere was carried out. This was followed by interviews and discussions with experienced construction practitioners in Ghana most of whom were Quantity Surveyors. Most of them narrated their experiences of contractor development in Ghana dating back to the pre-independence era (Ghana gained independence from British colonial rule on the 6<sup>th</sup> of March 1957). From the explanations given, it was possible to develop a general understanding of the subject matter in question to make a qualitative interpretation of the respondents' comments and to draw some conclusions.

## **GENERAL CONTRACTING**

The concept of 'general contracting' refers to the professional practice or system where an organisation or individual undertakes to supply the resources and services required to construct a project (as explained in a standard construction contract textbook by Murdoch and Hughes, 2008 and a procurement textbook prepared on behalf of practitioners by Hackett et al., 2007). General contractors are often responsible for the means and methods to be used in the construction of a project in accordance with the contract documents. In order to achieve their aims, it is common for general contractors to subcontract part of the work to other persons or firms that specialize in different types of work. Such specialist contractors are often referred to as subcontractors (as explained in a study on the changing role of subcontractors in construction carried out for the CIOB by Gray and Flanagan, 1989). A study on institution reform in British construction by Winch (2000: 148) noted that "one of the most important distinguishing features of the British construction industry compared to its European counterparts is the very early emergence of general contracting during the first half of the 19th century, while in the rest of Europe, it is much more associated with the period following World War II". Thus, general contracting dates back to the early part of the 19th century and practices has reformed over the years as a result of factors including government-led reform initiatives, changes in government procurement strategies, and increasing competition in the market. How general contracting evolved in the UK is also explained in a historical overview of technological change in the construction industry by Hughes and Hillebrandt (2003).

## **EVOLUTION OF GENERAL CONTRACTING IN THE UK**

General contracting in the UK has evolved from the earliest times when Monks built their early churches in wattle and daub and thatch did the work themselves (Hughes and Hillebrandt, 2003). As the work became more difficult, specialised tasks like masonry arose. However, monks still carried out simpler aspects of the work in construction and lay craftsmen performed most of the more difficult work.

In the UK and around Europe, the earliest craftsmen were masons and carpenters. With time, specialized artisans like tilers, slaters, thatchers, plumbers, glaziers, smiths, painters, plasterers and bricklayers emerged to provide specific parts of buildings. In England, some specialist craftsmen organized themselves from the beginning of the thirteenth century into a system of local craft guilds. This system was, however, not suitable for craftsmen like masons who had to constantly move from place to place in response to fluctuations in skills demand.

It was originally the practice for the client to employ each of the crafts directly (Hughes and Hillebrandt, 2003). With time, some master masons and carpenters took the step of taking responsibility for whole projects and employed their own tradesmen so that they could operate as building contractors. Thus, most of these early contractors were able to provide the design and construction but they were often employed to build only a part of the project, alongside other contractors and tradesmen employed directly by the client. In some contracts, the builder's contract was to supply materials, but in others, the employer provided the materials.

In the early part of the 19<sup>th</sup> century, Thomas Cubitt in the UK became one of the earliest general contractors (Hughes and Hillebrandt, 2003: 510-11). Cubitt employed all the craftsmen he needed and paid them regular wages. Prior to this, the usual practice was for tradesmen such as carpenters to subcontract their work to others. Thus, subcontracting is clearly an old feature of the construction industry. In medieval times, it was quite normal to encounter both labour-only subcontracting (where materials are provided for subcontractor to provide only labour) and supply-and-fix subcontracting (subcontractor provides materials and the components). Sometimes, even when general contractors have a large workforce, they still subcontract specialist items to subcontractors alongside their own workforce to deal with peaks in demand. Generally, most firms in the construction industry are small – mainly because of the size and geographic distribution of projects. Most jobs are small, even large projects lead to many small contracts because of subcontractors.

Nowadays, the financial structure of construction enterprises is very complex (Winch, 2000). A combination of government-led reform initiatives, changes in government procurement strategies, and increasing exposure to international competition has created a significant shift in the organisational and business strategy of construction firms. This has given rise to the development of large building and civil engineering contracting organisations particularly in the post World War II era.

## **RESEARCH QUESTION**

The preceding literature shows a clear documentation of the emergence of general contractors in the UK and some parts of Europe. However, the way that indigenous contractors and general contracting evolved in Ghana is not articulated in the literature. Therefore, this study focuses on the question: How did local or indigenous contractors evolve in Ghana? This question required a pragmatic and reliable method of investigation.

## **RESEARCH METHOD**

In order to ascertain how indigenous contractors evolved in Ghana, it was essential to talk to people with the relevant knowledge of how indigenous construction firms in Ghana have emerged and developed. As no major literature on the subject was found, the research started in 2007 and involved a period of initial discussions with Senior Quantity Surveyors in major construction firms in Ghana and in some cases Managing

Directors. Many of them have worked in the construction industry in Ghana for a long time and therefore shared a first hand knowledge of the evolution of many of the major construction firms in Ghana today. These practitioners also directed the researcher to other senior practitioners of the construction industry in Ghana whom they considered to possess sufficient knowledge about development in general contracting in Ghana. Thus, this resulted in the use of a purposive sampling approach, in that, some of the interviewees were first identified through personal contacts and they, in turn, assisted the researcher to contact other experienced construction practitioners in Ghana with relevant knowledge of indigenous contractor development in Ghana. Altogether, the data presented here was gathered mainly from interviews with 10 experienced practitioners of the construction industry in Ghana, most of whom are Quantity Surveyors, and have an average of 35 years' working experience. All interviews were unstructured in nature (similar to the format described in Denscombe, 2003: 176). The researcher introduced the topic and then each interviewee was given the freedom to recount their knowledge of the evolution of indigenous contractors in Ghana. Thus, the respondents were mainly asked to provide detailed descriptions of how indigenous contractors in Ghana have evolved. There were other questions related to the impact of different governments on contractor developments. However, these were mainly follow-up questions to some of the respondents' comments. Notes were taken as each interviewees explained indigenous contractor evolution and development in Ghana. The respondents' explanations and qualitative descriptions were collated and examined for qualitative interpretation.

## **DATA PRESENTATION ON EVOLUTION OF INDIGENOUS CONTRACTORS IN GHANA**

This section presents a collation and to some extent a discussion of the interviews and discussions with interviewees on the evolution of indigenous contractors in Ghana. The research indicated that in the colonial times, there was a government department of works responsible for construction works in the country including engineering, design and construction. Construction artisans in the country were all employees of the government of Ghana, which had a structured training programme for the artisans' skills development. The present Ghana Secondary Technical School (GSTS) in Takoradi served as a training centre for middle-level construction professionals at that time. The department of works was responsible for all public works, electricity supply, road construction and water supply. The department of works had an intensive apprenticeship scheme that was used for training and categorising labour.

Shortly before World War Two (WW2) in 1939-45 contractors had started to emerge in Ghana. Most of these early builders were of Italian origin including, E. Tononi; M. Barbissoti; J. Monta; Michelletti and De Simone. However, the nature of the alliances in WW2 carried implications for the Italian builders in the Gold Coast after WW2. WW2 was organised into two opposing military alliances: the Allies and the Axis. The Allies of WW2 comprised of nations including the British Empire, the Union of Soviet Socialist Republics, and the United States of America. The Axis powers of WW2 comprised of nations including Germany, Japan and Italy. Ghana, known as Gold Coast at the time, was by then a British colony and territory. This, at least in theory, meant that Ghana was part of the Allies in WW2 through British colonialism.

As WW2 started, Ghana's colonial masters (Britain) thought that Italians in the Gold Coast might hold sympathies for their home government and act as spies for their home government and feed it with information about British Empire activities in



Ghana. Therefore, most Italians in the Gold Coast were incarcerated by the British colonial government in the Gold Coast. Most of the Italians had come originally into the Gold Coast as master craftsmen in building construction. After WW2, a lot of devastation and destruction had occurred around the world. Therefore, the British colonial government in the Gold Coast decided to use the Italians incarcerated during WW2 as master craftsmen for developing infrastructure in the Gold Coast. The colonial government provided them with the capitalization needed to achieve the objective of employing them for developing infrastructure in the Gold Coast. This, in essence, may be considered as the real start of general contracting in Ghana.

With Italian craftsmen taking the lead in undertaking the construction of projects in the Gold Coast after WW2, some local Ghanaian indigenes also started to develop the entrepreneurial capacity to undertake projects. Many of them learned the know-how from the Italian master craftsmen. Apart from Italians craftsmen who dominated the local construction market in Ghana at the time, Taylor Woodrow, a British construction firm, and A-Lang, a Swiss construction firm, were also major contractors operating in the Gold Coast. Unlike the Italian contractors who had developed their businesses in Ghana, Taylor Woodrow and A-Land came into the Gold Coast as offshoot firms from their parent firms in Europe. Thus, they were already big contractors with organisational structures very different from Italian firms which had developed locally in Ghana. Because many of the indigenous Ghanaians who took to contracting learned the trade from Italian businesses, the local Ghanaian contractors structured and developed their firms after the model of the Italians firms.

With the advent of independence from British colonial rule on the 6<sup>th</sup> of March 1957, more local people were encouraged to go into contracting. In fact, right from the time preceding independence when Dr Kwame Nkrumah became Leader of Government Business in 1951 more local people were encouraged into construction. The Public Works Department (PWD) had grown in capacity in terms of number of skilled workers and operatives. As a result, some master craftsmen and technical supervisors who were employees of the PWD decided to set up their own private construction firms. But it is only the craftsmen and technicians who ventured into this. Professional employees of the PWD like engineers and architects did not venture into the new business of contracting because of the risk factor involved in business. In those days, engineers and architects employed by the government were very well paid. Hence, most of them had little financial incentive to leave their lucrative public sector posts for private business ventures more so considered as 'menial' and below their status. Most of the indigenous people who became contractors were therefore craftsmen and technicians who had construction experience and know-how. However, many of them did not have the estimating skills and sufficient capitalization to employ the services of professional estimators into their indigenous outfits. The option left to them was to engage the services of professional employees of the PWD on an occasional basis. This practice led to the adoption of the schedule of rates as the basis of construction contracts in order to make things easier for contractual parties.

With time, indigenous Ghanaian contractors grew bigger in size, and it became necessary for them to put appropriate organisational structures in place in order to become viable. There was therefore a need for them to employ professional staff like engineers and quantity surveyors. However, skilled professionals were not available in sufficient numbers and local contractors could still not afford to remunerate them to the level of attractive salaries the professionals earned from public sector employers

like the PWD. Therefore, most contractors did not have professional employees and thus could hardly perform any detailed analysis of pricing levels in bids.

As professionals were in short supply, this impacted negatively on the capacity of local construction firms and the government took the initiative to establish a Department of Building Technology at the Kwame Nkrumah University of Science and Technology in Kumasi in 1965 to train professionals for the construction sector in Ghana. The main vision for setting this up was to provide basic training in areas like building construction, structural design, building services, building quantities and contract administration. Many of the interviewees lamented that despite the establishment of the Department of Building Technology at KNUST, Kumasi, construction professionals in Ghana have not been able to meet the rising challenges of construction activities in Ghana.

Later on in the era after independence, the PWD was subdivided under different ministries such as the Ministry of Works and Housing (MoWH), Ministry of Roads and Highways (MoRH) and Ministry of Energy (MoE) with specific tasks and functions. The PWD now became the technical wing of the two ministries of Works and Housing and Roads and Highways. Further, other state corporations like the Ghana National Construction Corporation (GNCC) and the State Housing Corporation (SHC) were also placed under the MoWH. Most construction work was awarded on a design-and-build basis. Only in a few cases was a project designed by the PWD and built by the GNCC. Even with that, the purpose was mainly to suit the political climate and government policies of the time. With time, a public owned professional services firm known as the Architectural and Engineering Services Company (AESC) evolved from the PWD to provide specialised services in architectural and engineering designs.

The years following 1966 when the socialist government of the Convention People's Party led by Kwame Nkrumah was overthrown saw a reformation of the national political ideology and orientation from socialism towards capitalism. State institutions were thus reformed and restructured accordingly although the changes took place gradually. This development provided ground for further training in both the professional and technical level personnel for the industry in Ghana. Modern forms of procurement strategies and competitive tendering procedures started to emerge. Thus public companies like the State Construction Company (SCC) now had to compete for work. As institutions like the SCC (formerly GNCC) was run professionally, tendering was equally done on a professional basis. Institutions like the SHC also set the standards in community housing and planning. The colonial government built planned settlements in areas like Cantonments, Ridge, Korle Gorno and Osu in Accra. However, other subsequent planned settlements like Dansoman estates, Kanda and Labone were built by the publicly owned construction firms like the SHC.

The state institutions thrived and performed well. The professional approach taken by most firms reflected in pricing levels, competence and reliability of the estimates. The SCC for instance had planning, estimating, plant, joinery, electrical and plumbing departments, etc. The SCC also had competent professionals including site engineers and project managers. With this professional approach, the SCC led the way in the construction of projects in Ghana. Once the management of the SCC decided that a job should be tendered for, details of the job would be sent to the estimating department which typically had about 12-15 QSs. The tender will then be assigned to about two or three estimators depending on how big the job was with the Head of

Department overseeing every stage of the tender preparation process. Having arrived at a tender figure, there would be an adjudication meeting where every priced item and method will be justified to an adjudication panel. The adjudication panel typically comprised of the General Manager of the SCC, Chief Quantity Surveyor/Estimator, Planning Department Head and the Engineer heading the region where the project was to be located. The Engineer Quantities (the one who did the actual pricing) would sit with the panel and explain everything in the tender to the panel. The rationale for the adjudication exercise was to ensure that preliminary items especially plant and the method of construction envisaged would be appropriate for the works so that the estimate is not utopian. Thereafter, it will be decided whether the tender should be submitted and the senior management would give the margin of profit. Most interviewees indicated that unlike most practices nowadays, profit and overhead margins were not fixed. It depended on circumstances such as the level of competition envisaged, how desperately the contractor wanted the job, proximity to the contractor's workshops - advantages, and possibility of serial contracts that could be negotiated at higher profit margins. Once the adjudication process was done and done well, the contingency on the price was almost negligible. The expertise and in-depth knowledge of the estimator tended to play a great role. A margin could be added for contingency if the estimator was uncertain about the price.

As the years developed, strong private construction firms started to evolve alongside the state-run SCC and SHC. The private firms grew as a result of expanding construction activity in the country. With time, some of the private contractors were able to compete and even provide better remuneration for staff in comparison to the state institutions. They were thus able to attract more skilled and experienced staff. As a result, state institutions like the SCC started to decline around the early 1990s and privately owned construction firms now dominated the construction market in Ghana.

Thus, general contracting business in Ghana has evolved from times when Italian craftsmen were the main suppliers of construction goods and services before and after WW2 in 1939-45, to times when indigenous Ghanaian private construction firms also evolved strongly in pre-independence times soon after Dr Nkrumah became Leader of Government Business around 1951, to times when strong state-run institutions like the SCC and SHC dominated the market and constructed most projects in Ghana in the post-independence era after 1957. The emergence of strong private construction firms in Ghana led to the decline of state institutions like the SCC around the early 1990s. Nowadays, many large projects in Ghana, especially those that are one off and require a high level of expertise, are awarded to expatriate firms who come in mainly from Europe. Many of the early construction firms that came into Ghana from Europe have collapsed for example, A-Lang and ABU. However, others like M Barbissoti and Sons Ltd and De Simone Ltd have survived. One question for future research is the reasons why some firms have collapsed and others have survived. As many of the European firms in Ghana collapsed, many of the expatriates brought into the country to work for them decided to remain in the country and set up their own construction firms. Most of those new firms were set up in the early 1990s and have developed into leading firms in Ghana including firms like CONSAR Limited. Many of the leading construction firms in Ghana today are not owned by the indigenous people but mostly people of European, American or Chinese origin who register their firms with some Ghanaian partners in accordance with business registration laws in Ghana.

## **DISCUSSION AND CONCLUSION**

The study here presents preliminary insights on the evolution of construction firms in Ghana. The research indicates that indigenous general contracting in Ghana traces back to the pre-independence era around 1945 when the colonial government capitalized local Italian master craftsmen based in Ghana in order to develop infrastructure in response to devastations from WW2. Some of the indigenous people took inspiration from the Italians and set up their own construction firms. Many more indigenes were encouraged to set up construction firms from the period when Dr Nkrumah became Leader of Government business in 1951. Thus, whereas the industrial revolution gave rise to the surge of general contractors in places like Britain, it is the devastating effects of WW2 that gave rise to the surge of general contractors in Ghana.

Today, different categories of contractors operate in Ghana. There are indigenous and foreign contractors operate in Ghana (according to a newsletter of the Association of Road Contractors (ASROC) Ghana published in 2007) operating in the road sector or the building and civil engineering sector. Construction firms in Ghana today are required to register with the appropriate construction ministry if they are desirous of doing government projects (Eyiah and Cook, 2003). The Ministry of Works and Housing classifies building and civil engineering contractors as financial class D1, D2, D3 or D4 whereas civil engineering contractors are classified as K1, K2, K3 or K4. The Ministry of Roads and Highways classifies contractors into categories A, B, C and S. Contractors in each category are further grouped into financial classes 1, 2, 3 and 4 based on their technical and managerial expertise, financial standing, previous performance, and equipment and plant holding. The minimum requirement for classification into categories by the two ministries is well explained in studies of contractors in Ghana by Eyiah and Cook (2003) and Dansoh (2005). The ASROC (2007) publication identified problems affecting local contractors in Ghana as delays in payment, lack of adequate equipment holdings, quarry aggregates/chippings, lack of adequate supervision of contracts, inadequate preparation of projects, changes in bills of quantities, fixed contracts, presence of foreign contractors, and cancellation of advance mobilisation guarantee of Government of Ghana projects. Clearly, there are serious challenges facing contractors in Ghana. However, the contractors have no united front or common agenda to tackle the challenges. For example, Eyiah and Cook (2003) identified different contractor associations in Ghana. The Ghana Contractors Association was renamed the Civil Engineering and Building Contractors Association of Ghana (CEBCAG) in 1985. Conflict of interest resulted in the split of the association into the Association of Road Contractors and the Building Contractors Association. To become effective, local contractors in Ghana should collate their ideas and adopt a cooperative approach and attitude towards solving their problems.

Several private local construction firms have proliferated in recent times. However, many of them lack the capacity to undertake large projects. As a result, foreign contractors undertake most major projects in Ghana. There is little doubt that local firms need to enhance their capacity for carrying out large construction projects. This requires more efforts from government, in terms of enacting policies that will create an enabling environment for this to happen, and the contractor's themselves. The Association of Road Contractors Ghana has warned that there is a current threat to local construction firms, in that, foreign contractors are executing even maintenance jobs that can be done by local contractors to enhance their capacity. Foreign firms should be restricted to tendering for only major Class A1 projects which many local

firms do not have the capacity to execute. Maintenance jobs should be awarded to indigenous Ghanaian contractors only. It might also be necessary to create an environment where foreign contractors who win major projects would be required to sublet some portion of the job to indigenous contractors to help in the technology transfer process and enhancement of local contracting capacity. In the meantime, local contractors can also help themselves. One of the reasons the current construction market in Ghana is dominated by foreign contractors is that although local contractors possess sufficient technical expertise, many of them lack the capacity to carry out major projects because of low capitalization and poor organisational structures. In order to become major players in the market, local Ghanaian contractors should build strong organisational structures and pursue mergers and joint venturing to boost their financial, technical and managerial capacity for major projects.

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# THE INFLUENCE OF FACILITIES ON RENTAL VALUES AND VACANCY RATES IN HIGH RISE OFFICE RENTED PROPERTIES IN KADUNA STATE, NIGERIA

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The growth in economic activities have generally necessitated the desire to provide accommodation where business would be run away from residential accommodation, provision need to be made to take cognizance of diverse business: space requirements, cultural background and individual disposition. Attention is also focused on economics, space distribution and functionality. This study investigates the influence of facilities provided on rental values and vacancy rates of high rise office rented apartments, through extensive field survey, five high rise office rented apartments each ten-storey located in the linear road connecting the city centre was chosen for the study, two different semi structured questionnaires targeted at tenants and registered estate surveyors was used in data collection. Quantitative analysis using SPSS 14.0 shows that facilities are the key determinants of rental value per meter square in high rise office properties. The rental values vary by floor in the study area which shows that not only facilities in a property influence its rental value and vacancy rates this contrast to previous findings. The significance of this research is to provide a guide to property investors and building designers to ensure that facilities provided in high rise office properties have a functional lift that can be supported by alternative energy and should suite the use of the property by the tenants and their clients/customers and not just for aesthetics which do not add to the money value generators (mvg) in the property and which is inimical to the goal of a private property investor.

Keywords: facilities, vacancy rate, high rise, property, rental value, office.

## INTRODUCTION

Past studies on office properties have mostly focused on office rents (for example, see Matsamura, 2000a, 2000b) and vacant office space (for example, see Fuest and Mcallister, 2010. AEW, 2010; Bagh, 2009; Geade, 2009; Savillis, 2009; APM, 2009; CBRE, 2006; Viruly, 2000; Rosen, 1994; Sirmans and Benjamin, 1991). Facilities design (for example, see Salleh and Ruddock, 1999; Chris and Somefun, 2007; Oduwaye, 2004) and factors influencing the income of industrial properties (for example, see Rutherford and Eakin, 1993. Hughes 1994. Wheaton1990.) Office rent determinants (for example, see Glascock, Jahanian and Sirmans, 1991.) and Infrastructural services (for example, see Mabogunje, 1993.) Most of these studies agree that rental value affects vacancy rates but fail to incorporate the contribution of

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the facilities in rental value determinants. Also scholars have written on Office markets (for example, see Wheaton, 1999.) demography and Office market (for example, see Brounen and Eichholtz, 2004. Kling and McCue, 1987) and demand for office space (for example, see Sivitanides, 2007). Oduwaye (2004) reported that “access to good roads, drainages, electricity, and availability of standard facilities and amenities will increase property values at any particular time. Few studies have been carried out on the effect of infrastructural facilities on rental value (for example, see Olujimi and Bello, 2009). However this study dwell on residential properties, as little empirical attention has been paid to the influence of facilities on rental value and vacancy rates in high rise office properties. This study attempts to bridge the gap. The basic aim of this research is to explain the influence of facilities on rental value and vacancy rate in high-rise properties in a fairly large metropolitan area in Northern Nigeria. The following questions will be answered. What is the rental value per meter square in high rise? What are the facilities in the properties and their state of functionality.

## **RESEARCH PROBLEM**

The rental value per meter square of high rise office properties are fixed arbitrarily using the cost of construction and investors expected rate of return. The facilities provided in the property are mostly not used as rent determinant. The facilities provided in the property affects the occupancy and vacancy rates which means a percentage of the rent is influenced by the facilities provided.

## **STUDY AREA**

Kaduna is the capital of Kaduna state, it is a metropolitan area as well as a cosmopolitan industrialized state with over 80 commercial and manufacturing industries. Manufactured goods range from carpets, textiles, reinforced concrete materials, bicycles assembly, toiletries, and cigarettes in the state. Consumer goods produced range from dairy products to soft drinks, flour and groundnut oil. The nation's third petroleum refinery is located in Kaduna state. Kaduna is located between latitudes 10°51'N and 10°31' and longitudes 7°26'E and 7°43'E. It is ranked third in the 2006 population census with an estimated population of 6,066,562 people.

Kaduna is a polycentric town, however the first central business district is located at the stretch of Ali Akilu road from the North up to Ahmadu Bello way southwards covering a distance of about 10 kilometres, which is made up of mostly commercial properties. There are over 25 high rise properties, however only 6 of them are 10 storey high, out of which 5 were selected based on their functionality, these include Investment House built in 1979 owned by Kaduna state. Ahmed Talib House built in 1976 owned by the NNDC (Northern Nigeria Development Company, Jointly owned by the Northern States) Turaki Ali House built in 1978 owned by NNDC, Nagwamatse House built in 1984 owned by private investors and NNIL owned by NNIL (New Nigerian Investment Limited) built in 1974. All the properties have the following facilities; access road, drainage, fenced wall, toilets, security, water, electricity, refuse collection, parking lots, and lifts. However in spite of Nagwamatse House being the most recently built it is not in the best state of repairs in comparison to others.

## **RESEARCH METHOD**

This is an exploratory study designed to assess the influence of facilities on rental values and vacancy rates in high rise office properties in Kaduna, Nigeria. All the high



rise properties 10 storey in the CBD were considered for the study. Both primary and secondary data were collected from the tenants and managing Estate Surveyors and Valuers, secondary data include literature review, journals and published reports.

Five forms were issued to the estate surveyors and valuers managing the identified high rise office properties in order to obtain relevant information on the nature of facilities provided, number of offices, number of vacant, and the rental value per meter square. All five forms were returned. One hundred and ninety six questionnaire were given to randomly selected tenants occupying the high rise offices in order to get information on the state of the facilities provided as, the tenants are in a better position to provide such information as the end-users. Of the 196, one hundred and sixty-six questionnaires were returned representing 85%, which is adequate for this study. The facilities were coded on a scale of 1 to 4 as follows 1=bad, 2=good, 3=very good, 4=excellent. Field survey was carried out by the authors to corroborate the information provided by the tenants on the state of the facilities.

Data table inputted into SPSS

Variable	Description	Data type	Measure
Propert	Property name	Numeric	Nominal
Numberv	Number of vacant offices	Numeric	Ordinal
Rentalv	Rental value per meter	Numeric	Ordinal
Accessro	Access road	Numeric	Ordinal
Electrici	Electricity supply	Numeric	Ordinal
Watersu	Water supply	Numeric	Ordinal
Refusec	Refuse collection	Numeric	Ordinal
Toilet	Toilet condition	Numeric	Ordinal
Drainage	Drainage facilities	Numeric	Ordinal
Fenced	Fenced wall	Numeric	Ordinal
Security	Security personnel	Numeric	Ordinal
Parking	Parking lot	Numeric	Ordinal
Lift	Lift functionality	Numeric	Ordinal

## RESULTS

The data collected was analysed using SPSS 14.0. Correlation and multiple regression analysis was carried out in order to develop a model for the dependent variable using the predictors (facilities provided) in the high rise office properties.

Table showing the condition of the facilities in the properties

Facilities	Investment house	Ahmed Talib house	Turaki Ali house	Nagwamatse house	Nnil building
Toilet	4	3	4	2	3
Electricity	3	4	2	1	3
Access road	4	3	4	4	3
Security	3	3	4	3	4
Lift	4	3	3	4	4
Fenced wall	4	4	4	4	4
Water	3	4	3	3	2
Refuse collection	3	2	4	4	3
Parking lot	4	3	4	4	4

Legend 1=bad, 2=good, 3=very good, 4=excellent

The model developed was able to predict 91.4 % of the variation in the dependent variable by the predictors, it also show that the model is significant  $R^2=91.4$   $p<0.05$ ,

(table 1) which agrees with earlier studies that facilities provided in a property has significant influence on the rental value of the property (see, Olujimi and Bello, 2009).

Table 1: Model summary for predictor and dependent variable

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					Change	Change	df1	df2	g. F Change	
1	.967	.935	.914	188.562	.935	43.350	1	3	.007	
2	1.000	1.000	1.000	.000	.065	.	1	2	.	1.000

TABLE 3 SHOWING THE CO-EFFICIENTS FOR THE PREDICTOR AND DEPENDENT VARIABLE

Model		Unstandardized Coefficients		Standardized Coefficients		t	Sig.	95% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta				Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-2000.000	625.389			-3.198	.049	-3990.266	-9.734					
	LIFT FUNCTIONALITY	1133.333	172.133	.967		6.584	.007	585.531	1681.136	.967	.967	.967	1.000	1.000
2	(Constant)	-5600.000	.000			-143865401	.000	-5600.000	-5600.000					
	LIFT FUNCTIONALITY	1800.000	.000	1.536		238047583	.000	1800.000	1800.000	.967	1.000	.627	.167	6.000
	DRAINAGE FUNCTIONALITY	400.000	.000	.623		96580763.6	.000	400.000	400.000	-.779	1.000	.254	.167	6.000

Lift Functionality was the major contributor in the model, this supports the fact that most of the vacant offices were in the upper floors of the properties, however the second model included drainage as a facility that may influence the rental value per meter square in high rise office properties, it is obvious that lift will play a major role in rent determinants especially in properties that are above 5 storey high, however in the study area as tenants move to upper floors the rental value per meter square drops to about half the amount charge for lower floors, this may be due to unreliability of the lift, which depends on electricity rather than on customers/clients not wanting to move to upper floors to transact business, which is the general belief amongst practising estate surveyors in the metropolis. Investment house, Nagwamatse house, NNIL building with excellent lift functionality have .zero, thirty seven and 3 vacant offices in the eight floor. Ahmed Talib House and Turaki Ali house with very good lift functionality has .zero and two vacant offices. The constant which is the intercept has a negative sign for both models which shows that as the facilities functionality increases the sign may likely change, because most of the correlated facilities have a mean values of 3. This is not far from the fact that the un-correlated items had a lower scale rating.

The table of means and standard deviation indicates that the average number of vacant offices in each of the 5 high rise 10 storey building was about 8 offices per property, could have a rental value per meter square of N 2080 and access road has a mean of over 3 representing very good, all other facilities identified in the high rise office properties had an average rating of a little above 3 which is very good except electricity supply which had an average of above 2 which is good, this may not be far from the fact that the power generated in the country is far below the expected consumption rate of 4500 megawatts (PHCN, 2009) hence the erratic supply of electricity in most towns in the country.

Descriptive Statistics

	N	Mean	Std.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
NUMBER OF VACANT OFFICES	5	8.40	16.041	2.200	.913	4.868	2.000
NUMBER OF OCCUPIED OFFICES	5	75.20	25.312	-.324	.913	-.089	2.000
RENTAL VALUE PAR METER SQUARE	5	2080.00	641.872	-.299	.913	-2.718	2.000
ACCESS ROAD	5	3.60	.548	-.609	.913	-3.333	2.000
ELECTRICITY SUPPLY	5	2.60	1.140	-.405	.913	-.178	2.000
WATER SUPPLY	5	3.00	.707	.000	.913	2.000	2.000
REFUSE COLLECTION AND DISPOSAL	5	3.20	.837	-.512	.913	-.612	2.000
TOILET CONDITION	5	3.20	.837	-.512	.913	-.612	2.000
DRAINAGE FUNCTIONALITY	5	3.00	1.000	.000	.913	-3.000	2.000
FENCED WALL	5	4.00	.000	.	.	.	.
SECURITY PROVISION	5	3.40	.548	.609	.913	-3.333	2.000
LIFT FUNCTIONALITY	5	3.60	.548	-.609	.913	-3.333	2.000
PARKING LOT	5	3.80	.447	-2.236	.913	5.000	2.000
Valid N (listwise)	5						

## ANALYSIS OF THE FACILITIES AND THE VARIABLES

The analysis of the Zero order correlation matrix(table 5) indicates that few of the observed relationships were very strong. Between the 10 key variables, rental value par meter square meter has significant relationship with 7 of the variables, rental value par meter square is related to electricity supply, water supply, refuse disposal, toilet facilities, security, parking lot and lift functionality, there was no correlation with drainage, fenced wall and access road, this may be as a result of the properties all situated in the CBD, less water is used in the property because it is an office building rather than a residential building where people bath, wash clothes and plates, cook hence the need for a good drainage system. Lift is a necessary facility in a high rise office property, there are less incidence of theft in office buildings than residential properties, hence the reason why fenced wall may not have a strong relationship with the rental value par meter square of high rise office Properties. The positive correlations means that as X increases Y also increases that is as rent par meter square increases the state of functionality of the facilities increases, however this is not the case because more money is spent on diesel for running the generators to the detriment of other facilities, also the managing surveyors do not have a preventive maintenance policy of the facilities, only curative maintenance are carried out, after a breakdown of the facilities, this may take a long period due to bureaucratic bottleneck

## CONCLUSION

This paper has been able to explore the influence facilities have on the rental values and vacancy rates in high rise office rented properties. As observed in the model the intercept (constant) was negative. This is because the variable predicting the dependent variable is lift functionality which is highly dependent on electricity supply, 7 other variables were related to the rental value par meter square, which were however not identified in the 2 multiple regression model, this may be because the properties are high rise office properties, number of vacant offices has a weak relationship with rental value par meter square, 307, but it is a positive relationship which means that both rental value par meter square and number of vacant offices are influenced by the facilities provided in the high rise office properties.

TABLE 6: ZERO ORDER CORRELATION MATRIX

Control Variables		WATER SUPPLY	ACCESS ROAD	ELECTRICITY SUPPLY	REFUSE COLLECTION AND DISPOSAL	TOILET CONDITION	DRAINAGE FUNCTIONALITY	FENCED WALL	SECURITY PROVISION	PARKING LOT	LIFT FUNCTIONALITY	NUMBER OF VACANT OFFICES	RENTAL VALUE PAR METER SQUARE
None	WATER SUPPLY	Correlation Significance (2-tailed) df	1.000 0 3	.000 .612 3	.310 .478 3	.000 1.000 3	.354 .559 3	.000 .625 3	.545 .239 3	.191 .111 3	.545 .239 3	.545 .916 3	.545 .127 3
	ACCESS ROAD	Correlation Significance (2-tailed) df	1.000 0 3	1.000 -.721 3	.000 .184 3	1.000 .218 3	.000 -.456 3	1.000 .625 3	.000 -.167 3	.000 .512 3	.000 .167 3	.000 .383 3	.000 -.028 3
	ELECTRICITY SUPPLY	Correlation Significance (2-tailed) df	.000 .612 3	1.000 .170 3	.310 .333 3	.000 .333 3	.354 .460 3	1.000 .625 3	.545 .239 3	.191 .111 3	.545 .239 3	.545 .916 3	.545 .127 3
	REFUSE COLLECTION AND DISPOSAL	Correlation Significance (2-tailed) df	-.423 .478 3	.764 .133 3	-.943 .016 3	1.000 .000 3	-.071 .309 3	-.299 .625 3	.000 .625 3	.327 .103 3	.802 .724 3	.570 .316 3	.149 .811 3
	TOILET CONDITION	Correlation Significance (2-tailed) df	.000 1.000 3	.218 .724 3	.367 .544 3	1.000 .000 3	.299 .625 3	1.000 .625 3	.000 .625 3	.327 .103 3	.802 .724 3	.570 .316 3	.149 .811 3
	DRAINAGE FUNCTIONALITY	Correlation Significance (2-tailed) df	.354 .559 3	-.456 .440 3	.439 .460 3	-.289 .625 3	.299 .625 3	1.000 .625 3	.000 .625 3	.456 .327 3	-.559 .030 3	-.545 .342 3	-.779 .121 3
	FENCED WALL	Correlation Significance (2-tailed) df	.000 1.000 3	.218 .724 3	.367 .544 3	1.000 .000 3	.299 .625 3	1.000 .625 3	.000 .625 3	.327 .103 3	.802 .724 3	.570 .316 3	.149 .811 3
	SECURITY PROVISION	Correlation Significance (2-tailed) df	-.645 .239 3	-.167 .789 3	-.080 .898 3	.327 .591 3	.456 .591 3	.000 .625 3	1.000 .625 3	.408 .440 3	-.167 .440 3	-.336 .581 3	.028 .964 3
	PARKING LOT	Correlation Significance (2-tailed) df	-.791 .111 3	.612 .272 3	-.688 .201 3	.184 .103 3	.218 .327 3	.000 .625 3	.167 .440 3	.512 .724 3	.167 .316 3	.383 .804 3	-.028 .811 3
	LIFT FUNCTIONALITY	Correlation Significance (2-tailed) df	-.645 .239 3	-.167 .789 3	-.080 .898 3	.327 .591 3	.456 .591 3	.000 .625 3	1.000 .625 3	.408 .440 3	-.167 .440 3	-.336 .581 3	.028 .964 3
	NUMBER OF VACANT OFFICES	Correlation Significance (2-tailed) df	-.066 .916 3	.393 .513 3	-.809 .097 3	.570 .342 3	-.808 .581 3	-.545 .633 3	-.336 .480 3	.293 .480 3	.421 .480 3	1.000 .000 3	.307 .615 3
	RENTAL VALUE PAR METER SQUARE	Correlation Significance (2-tailed) df	-.771 .127 3	-.028 .964 3	-.219 .724 3	.149 .811 3	-.317 .634 3	-.779 .121 3	.000 .625 3	.028 .342 3	.592 .342 3	.967 .342 3	1.000 .000 3
RENTAL VALUE PAR METER SQUARE	WATER SUPPLY	Correlation Significance (2-tailed) df	1.000 0 2	-.034 .966 2	.228 .772 2	-.489 .511 2	-.404 .586 2	-.619 .381 2	-.980 .020 2	-.651 .349 2	.619 .381 2	.281 .719 2	.281 .719 2
	ACCESS ROAD	Correlation Significance (2-tailed) df	-.034 .966 2	1.000 0 2	-.745 .255 2	.777 .223 2	.221 .779 2	-.764 .236 2	-.166 .834 2	.764 .219 2	.422 .578 2	.422 .578 2	.422 .578 2
	ELECTRICITY SUPPLY	Correlation Significance (2-tailed) df	.228 .772 2	-.745 .255 2	1.000 0 2	-.944 .056 2	.322 .678 2	.438 .562 2	-.076 .924 2	-.438 .562 2	-.789 .201 2	-.789 .201 2	-.789 .201 2
	REFUSE COLLECTION AND DISPOSAL	Correlation Significance (2-tailed) df	-.489 .511 2	-.944 .223 2	1.000 .056 2	-.026 .974 2	.088 .705 2	-.295 .705 2	.088 .673 2	.295 .705 2	.088 .443 2	.088 .443 2	.088 .443 2
	TOILET CONDITION	Correlation Significance (2-tailed) df	-.404 .596 2	.221 .779 2	-.026 .678 2	1.000 .974 2	.088 .705 2	.295 .705 2	.088 .673 2	.295 .705 2	.088 .443 2	.088 .443 2	.088 .443 2
	DRAINAGE FUNCTIONALITY	Correlation Significance (2-tailed) df	-.619 .381 2	-.944 .223 2	1.000 .056 2	-.026 .974 2	.088 .705 2	-.295 .705 2	.088 .673 2	.295 .705 2	.088 .443 2	.088 .443 2	.088 .443 2
	FENCED WALL	Correlation Significance (2-tailed) df	.000 1.000 2	.218 .724 2	.367 .544 2	1.000 0 2	.299 .625 2	1.000 .625 2	.000 .625 2	.327 .103 2	.802 .724 2	.570 .316 2	.149 .811 2
	SECURITY PROVISION	Correlation Significance (2-tailed) df	-.980 .020 2	-.020 .966 2	-.076 .772 2	.327 .511 2	.355 .586 2	.764 .381 2	1.000 .020 2	.486 .349 2	-.764 .381 2	-.362 .719 2	-.362 .719 2
	PARKING LOT	Correlation Significance (2-tailed) df	-.651 .349 2	.781 .219 2	-.708 .292 2	.896 .104 2	.420 .807 2	-.193 .200 2	.486 .349 2	1.000 .020 2	.193 .200 2	.145 .855 2	.145 .855 2
	LIFT FUNCTIONALITY	Correlation Significance (2-tailed) df	.619 .381 2	-.764 .236 2	-.438 .562 2	.295 .705 2	-.088 .912 2	-.1000 .000 2	-.764 .349 2	.193 .200 2	1.000 .020 2	.513 .487 2	.513 .487 2
	NUMBER OF VACANT OFFICES	Correlation Significance (2-tailed) df	.281 .719 2	.422 .578 2	-.799 .201 2	.557 .443 2	-.788 .212 2	-.513 .487 2	-.362 .638 2	.145 .855 2	.513 .487 2	1.000 .000 2	.000 .000 2

Table Caption

a. Cells contain zero-order (Pearson) correlations.

The study has shown that electricity,water supply,refuse collection,toilet facilities,security,parking lot and lift functionality are key determinants in rental value par meter square of high rise office apartments in Kaduna Metropolis, Which agrees with previous studies,however lift was not identified in past studies this may be because most of the studies were on residential properties.That means property developers should endeavour to provide these facilities in high rise office properties in order to secure optimum rent.Alternative source of energy should be considered in powering the lift in high rise office properties because of the erratic power supply.Future research can focus on how the facilities are maintained in high rise and the cost implication on the revenue generated as an outgoing.

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# THE LEAN PROJECT DELIVERY SYSTEM (LPDS): APPLICATION AT THE DESIGN AND DOCUMENTATION STAGE OF BUILDING CONSTRUCTION PROJECTS IN GHANA

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Construction firms in Ghana are faced with the challenge of aptly delivering services and products to clients at the possible minimum cost in order to remain competitive in the industry. Therefore, it is crucial for these firms to “think lean” by exploring project delivery systems which focus on delivering value to clients and minimising waste in the project delivery process. This paper aims at establishing the possibility of adopting lean production principles by construction firms in Ghana in order to address the problems of delays, high cost of project delivery and waste. Data on the design and documentation activities of the firms was collected by administering questionnaires to consultants, while contractors and clients were interviewed. A personal observation of some of design and documentation activities was also carried out. Results of the study revealed that important activities in the Lean Project Delivery System like design criteria formulation and process design were not carried out at the design stage by most firms in Ghana. It was also found that inadequate familiarity of the firms with the concept of lean thinking was among a number of limitations in the possible application of the lean project delivery system in the Ghanaian construction industry. The possible transfer of knowledge in the application of the lean thinking concept from foreign construction firms operating in Ghana was one of the opportunities identified for the practice of lean thinking in Ghana.

Keywords: project delivery, lean thinking, lean project delivery system, value, cost.

## INTRODUCTION

The current liberal global economic order makes it challenging for Ghanaian firms in the construction industry to remain competitive worldwide. Obtaining a good market share, maintaining a high customer loyalty, and at the same time operating at reasonable profit are very important for the Ghanaian firms to compete effectively with their foreign counterparts. A survey conducted by Nicco-Annan (2006) on the construction of some office buildings in Accra reveals cost overruns of between 60%-180%, not taking inflation into account. Time overruns of between 12-24 months was also observed, according to Nicco-Annan (2006), from a survey conducted on the construction of some office buildings in Accra.

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The challenge of dealing with the issue of high cost of construction, while speeding up the value delivery process of construction products and services has, therefore, led to the need to explore production management systems, which optimize value delivery to customers while minimizing waste. Lean production is a production management based project delivery system that emphasizes reliable and speedy delivery of value. The aim of the research is to establish the possibility of adopting lean production principles by Ghanaian firms in the construction industry in order to minimise waste and maximize value in their project delivery processes.

## THE LEAN PROJECT DELIVERY SYSTEM (LPDS)

The Lean Project Delivery System (LPDS) was developed by the Lean Construction Institute (LCI) to apply principles pioneered in manufacturing to construction. LPDS tools facilitate planning and control while maximizing value and minimizing waste throughout the construction process. Ballard (2000b) describes LPDS as a production management-based approach to designing and building capital facilities in which “the project is structured and managed as a value generating process”.

The Lean Project Delivery System is formulated as a philosophy, a set of interdependent functions (at the systems level), guidelines for decision making, steps for execution of functions, and as implementation aids and tools, including software where appropriate (Ballard, 2000b). The limits of the domain of LPDS, states Ballard (2000b), are defined by an intersection of projects and production systems known as project-based production systems.

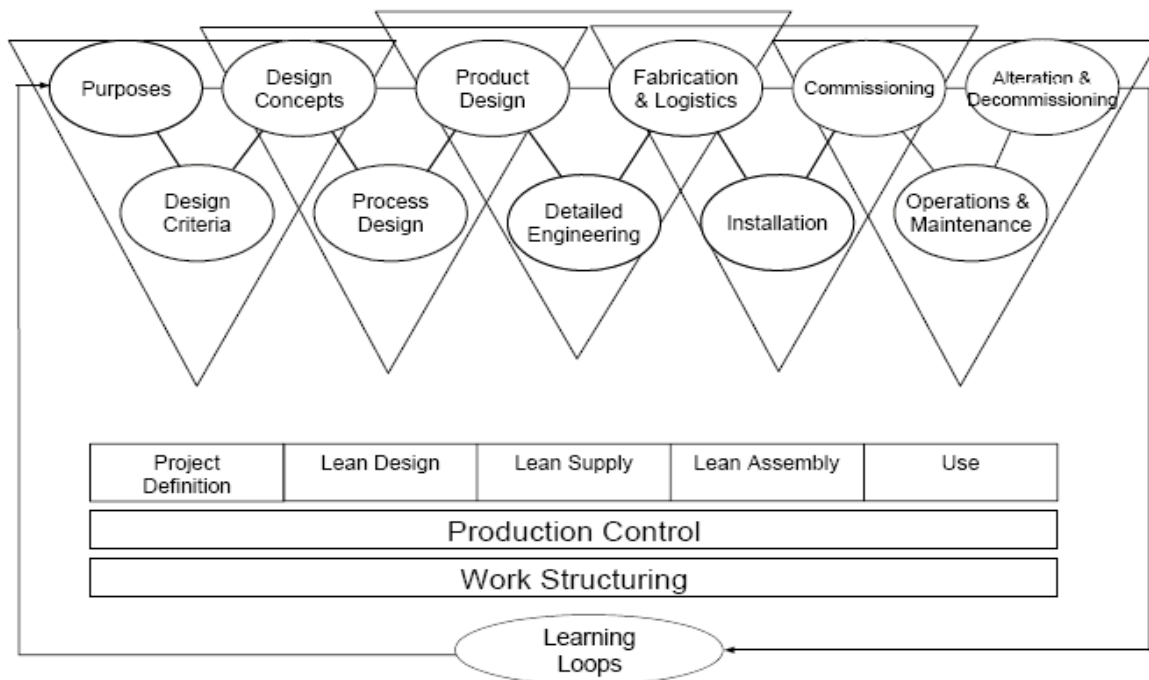


Figure 1: Lean Project Delivery System (Ballard 2003)

The LPDS model, according to Ballard (2003), consists of modules organized into interconnecting triads representing five different project phases (Figure 1). Each phase is represented by a triangle containing essential steps that lead to the completion of projects. There are also two production control modules and the work structuring module, both conceived to extend through all project phases. The post-occupancy



evaluation module (also known as learning loops) links the end of one project to the beginning of the next.

## **MATERIALS AND METHODS**

The research involved representative samples of the various Ghanaian consultancy and construction firms located in various parts of Ghana. This was an opportunity to critically explore and examine the steps in the pre-contract activities of Ghanaian consultancy and construction firms – site survey, design brief formulation, sketch and detailed design, obtaining permits, preparation of bills of quantities, tender documentation and contract documentation.

The Lean Project Delivery System (LPDS) model, developed by Ballard (2003), was used as the basis for assessing the extent to which the various steps of the pre-contract activities of Ghanaian firms fall in line with the concept of lean thinking. The steps were examined and assessed within the broad framework of lean project definition, lean design, lean supply, lean assembly and use.

### **Target population**

The core target population for data collection using questionnaires consisted of consultants (architects, engineers, quantity surveyors, etc). The focus on the consultants in the administration of the questionnaire was due to the key role consultants play in pre-contract activities. Contractors (building and civil) and clients (public and private) were also interviewed in some special cases.

### **Procedure for data collection**

A sample of 25 firms providing design and documentation services at the pre-contract stage of construction projects across the country were considered in administering the questionnaires. Three professionals (architect, quantity surveyor and engineer) in each of the firms were identified and given the questionnaire for their responses. In the case of the firms who did not have all the professionals in-house, their associate professionals were contacted for their responses to the questionnaire. A personal observation of some activities of some of the selected firms also provided an opportunity to obtain special information for the study. Ten major clients of some of the selected firms as well as some fifteen contractors who have worked with them were also interviewed to obtain information especially on their level of involvement by the firms at the pre-contract phase of the project delivery process.

## **FINDINGS**

### **Familiarity of firms with the concept of lean thinking**

It was observed that there is some level of awareness among Ghanaian consultants regarding basic principles of managing production systems to minimize waste but maximize value for clients in the project delivery process. There is however a very big gap between the awareness of these basic principles of waste minimization and value maximization on one hand, and a conscious effort by the firms to establish project delivery systems that focus on waste minimization and value maximization on the other hand.

It is worth noting that even though about 5% of the respondents, as shown in Figure 2 below, gave an indication that they have been involved in the application of the concept of lean thinking, they admitted that no special lean production system like the lean project delivery system (LPDS) was applied. Their intimation was that once they

try to basically ensure that waste was reduced even in the conventional project delivery system, they were applying the concept of lean thinking.

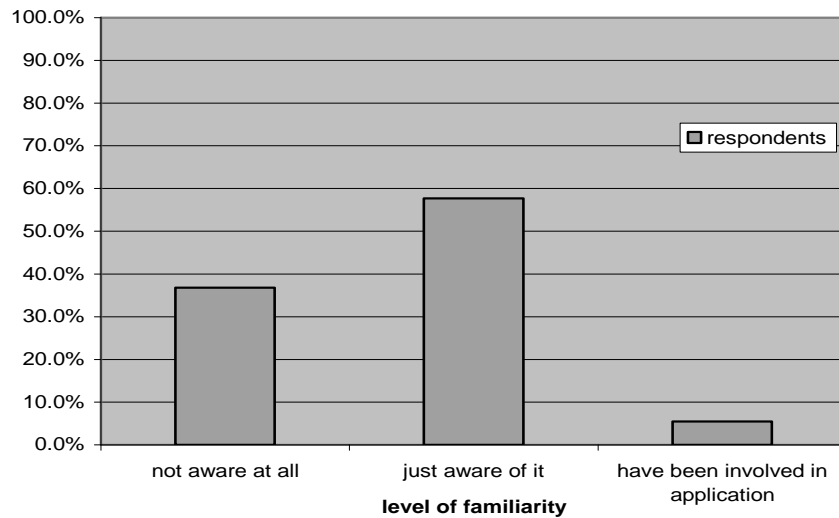


Figure 2: Familiarity of consultants with lean thinking concept

### Application of the lean project delivery system (LPDS)

It was revealed from the survey that most activities carried out by the consultants at the pre-contract stage are outside the context of the lean project delivery system. Process design at the design phase is a very important activity in the lean project delivery system. However Figure 3 shows that only 13.2% of the respondents gave an indication that they undertook process design at the design phase of projects. It was also revealed from the study that product design was undertaken only at the design phase by most consultants contrary to a requirement by the lean project delivery system that the product design process be balanced between the design and supply phases. While about 80% indicated that they undertook product design at the design phase, only about 20% gave an indication that they undertook some form of product design at the supply phase of the project delivery process (see Figure 3).

The less integration of design and supply activities by Ghanaian firms is further manifested in the indication by 69.1% of the respondents that they undertook detailed engineering at the design phase while only 20.6% indicated undertaking detailed engineering at the supply stage, as shown in Figure 3 above. Another significant deviation from the requirements of the lean project delivery system is reflected in the fact that design criteria is not only uncommon in the activities of the consultants, but also mostly concentrated at the design stage by the few who undertake it. The requirement of the lean project delivery system is that design criteria formulation should be carried out at the project definition phase.

Work structuring and production control are required by the lean project delivery system to be carried out across all the various phases of the project delivery process. The survey however showed that work structuring and production control are undertaken by very few consultants especially at the project definition, design, and supply phases of the project delivery process. Figure 3 also shows that only 20.6% and 7.4% of the respondents indicated that at the design stage they undertook work structuring and production control respectively.

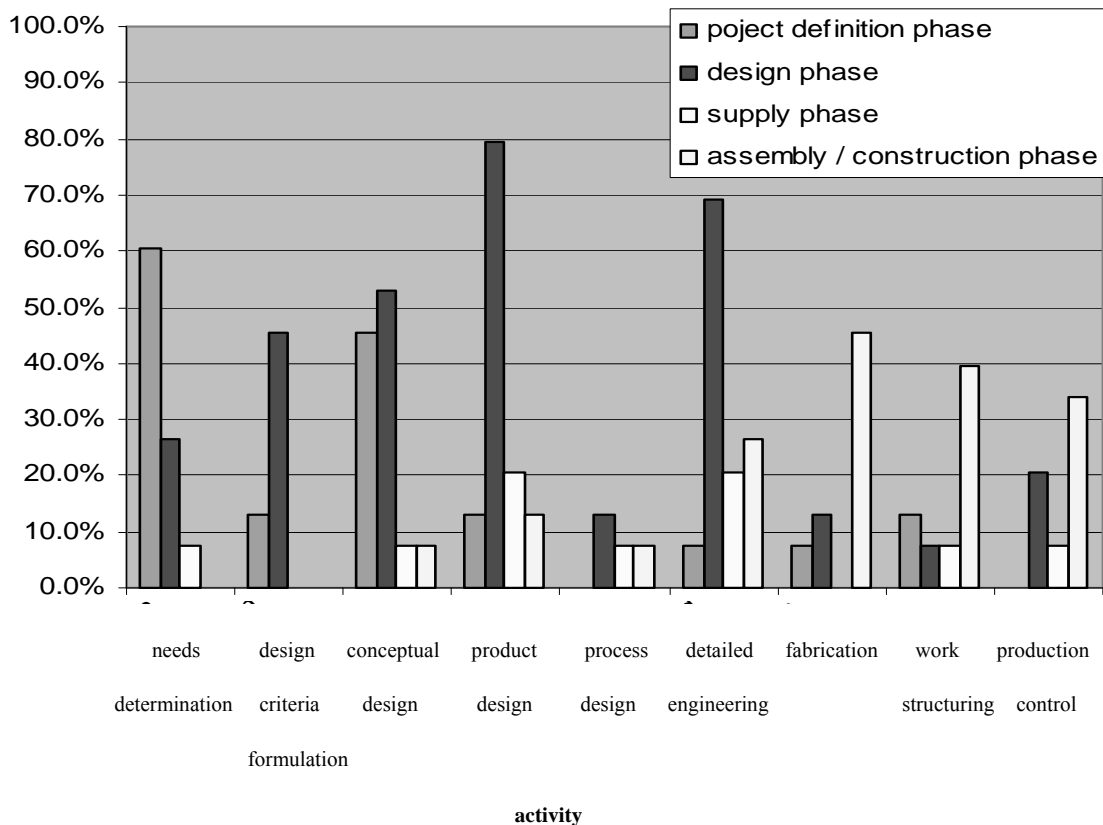


Figure 3: Activities undertaken in the project delivery process at various phases

## DISCUSSION

### Level of familiarity with the lean thinking concept

The survey revealed, as in Figure 3, a low level of familiarity of Ghanaian firms with the concept of lean thinking. The few consultants who are even aware of the concept of lean thinking have never adopted a special system like the lean project delivery system (LPDS) to consciously reduce waste and maximize value to clients. The traditional procurement system whereby the design and documentation activities are completely separated from construction activities is still the most widely used system in the project delivery process.

### Waste in the project delivery process

Even though some level of consciousness regarding the waste associated with project delivery steps exist in Ghanaian firms, design and documentation processes at the pre-construction stage still typify such sources of waste as waiting, delays, defects and inventories. These sources of waste despite having serious adverse effect on the speedy delivery of value to clients seem too subtle to be tracked by consultants. Responses from consultants during the survey for instance revealed that about 73% and 60% were unaware of negative design iteration and design errors respectively, as sources of waste. Given that one of the primary activities in the effective application of lean thinking requires identifying and eliminating waste, an inability to recognize waste in design and documentation is a big setback towards implementing lean thinking principles.

## **Process design**

Process design is hardly carried out at the pre-construction stage by consultants. Most of the consultants focus only on the design of the product while the process of fabricating or installing the product is left for the contractor to decide during the construction phase of projects. This has led, in most cases, to problems of buildability resulting in a lot of waste arising from waiting, delays, over processing and over production during construction. Just about 13% of the consultants indicated during the survey that they occasionally undertake some form of process design during the design and documentation stage (Figure 3). The low level of involvement of specialists and contractors during design and documentation partly accounts for the neglect of process design during pre-construction activities. Most contractors and specialist interviewed indicated that uncertainty about construction process was one of the problems that affected progress of work on site.

## **Involvement of project participants**

Management of design and documentation activities at the pre-contract stage by most Ghanaian firms falls short of what is required by the tenets of lean thinking to minimize waste and maximize value to clients. The level of involvement of various project participants in the various stages of design and documentation processes is very low thus limiting continuous flow in design and documentation, as well as resulting in waiting, delays and unnecessary processing.

The activities of the architect at the design stage, for instance, were found in most cases to be separated from that of the structural engineer and services engineer. The architect would therefore usually complete his designs without the involvement of the structural and services engineer and then gives the completed detailed architectural designs to them for the structural and services details. This practice will clearly inhibit continuous flow in the design process and result in waiting and delays.

## **Planning and control of design and documentation processes**

Most of the projects in all surveyed consultancy firms were being designed and documented without reference to any activity programme or work plan specifically drawn for the design and documentation processes. Most of the consultants admitted that even though as a result of demands from some clients they tried to provide an activity schedule for some design and documentation activities, it was not part of their usual practice to draw activity schedules and work plans when designs were being undertaken. It was therefore not surprising that lean design techniques involving the use of the activity definition model, set based design and design structure matrix were completely unfamiliar to virtually all the consultants. It is thus obvious that planning and control of design activities and processes to minimize waste but maximize value is generally not common among consulting firms in Ghana.

## **Limitations to the practise of lean thinking in Ghana**

Apart from the general problems that are seen to be associated with the implementation of lean thinking everywhere, some peculiar problems exist in the Ghanaian construction industry against the application of the tenets of lean thinking. One of these peculiar limitations is the Public Procurement Act of 2003 that prescribes procurement procedures involving public sector projects in line with the traditional system such that that integration of design and construction activities is undermined. Delayed processing of development permits and certificates as well as the generally low familiarity of Ghanaian firms with the concept of lean thinking are other

challenges against the implementation of lean thinking in Ghana. Another limitation is that the current level of technology in Ghana does not support the use of industrialized and modular building systems to speed up project delivery in line with the principles of lean thinking.

### **Opportunities for the practise of lean thinking in Ghana**

Notwithstanding the challenges that exist against the implementation of lean thinking in Ghana, some opportunities also exist. The appreciation by Ghanaian firms, as established from the survey, of the need to minimize waste and obtain value for clients in the project delivery process is a positive step towards introducing systems in the application of lean thinking Ghana. The need to conform to certain design standards as required by some statutory regulations can contribute immensely towards ensuring quality of products and services delivered to customers thus enhancing value delivery. Current trends of globalization is also likely to enhance the transfer of technology to Ghana to support attempts at adopting standardized and prefabricated modular building systems required in lean thinking practices.

## **CONCLUSIONS AND RECOMMENDATIONS**

### **Conclusions**

There is generally a low level of familiarity with the concept of lean thinking among Ghanaian firms. Even though some level of awareness exists among Ghanaian firms on the need to minimize waste but maximize value in the project delivery process, the firms fail to consciously put in place, lean systems like the lean project delivery system to ensure waste minimization and value maximization in the project delivery process.

Certain peculiar circumstances in the Ghanaian construction environment like statutory obligations and requirements, low familiarity with the concept of lean thinking as well as low industrialization and standardization of building systems are potential limitations that exist against the application of the concept of lean thinking in Ghana.

Notwithstanding the limitations against the application of lean thinking in Ghana, there are opportunities like the fact that the current trend of globalisation and information technology offers a lot of avenues for Ghanaian firms to get exposed to systems and techniques that support a smooth implementation of the concept of lean thinking.

### **Recommendations**

It is recommended that professional bodies such as the Ghana Institute of Architects (GIA), the Ghana Institution of Surveyors (GhIS) and the Ghana Institution of Engineers (GhIE) should expose their members to the concept of lean thinking through some form of continuing professional development programmes. There is also the need for the teaching of the concept of lean thinking to be introduced or strengthened in the academic and professional training of students pursuing construction related disciplines. Besides, a rationalised design and construction approach through standardisation and modularisation should generally become the drive behind the design and documentation decisions of Ghanaian consultants.

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# THE MACROECONOMIC REVIEW OF BUILDING AND CONSTRUCTION SECTOR IN NIGERIA: PRE 1980-2006

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The significance of the Building and Construction (B&C) sector in the economy makes its study imperative, and the understanding of how the sector react to the changes in the macroeconomic environment in a country overtime will no doubt assist in the formulation of economic policy germane to the sector. This paper reviews the macroeconomic environment in Nigeria and its effects on the B&C output before 1980 up to 2006. To achieve the study objective, a review of relevant literatures was carried out and supported with economic data to explain the B&C sector performance with respect to that of the general economy over the period. The study found out that the B&C sector indeed responded to the various changes experienced in the macroeconomic environment with significant impact on the sector's growth and performance. Structural problems that pose as challenges to raising the B&C sector output were also identified. These include high import content of capital, labour, and materials; skills and materials shortage; inadequate finance and delays in payments; dominance of foreign contractors; inadequate local capacity and high rate of corruption. These bring to the fore the need for effective economic planning for the B&C sector vis-à-vis other sector in the general economy with the intent of mitigating this trend. The study concludes with some recommendations for policy which includes active participation of the private sector in the provision of infrastructural facilities; repair and maintenance of existing stock of physical infrastructure; creation of favourable economic climate and the establishment of framework geared toward the construction industry technological development.

Keywords: economy, macroeconomic review, Nigeria.

## INTRODUCTION

The significance of the Building and Construction (B&C) sector in the economy can not be overemphasized. This is supported by the fact that construction is the only sector of the economy that appears twice (as one of the sectors that compound gross domestic product by industrial origin, and, as a component of a country's gross fixed capital formation) in National Account Statistics according to the United Nations system of national accounts conventions as noted by Lopes (1998). In Nigeria, the B&C sector consists of all establishments involved with the development of residential and non-residential buildings as well as civil engineering works. According to Obadan and Uga (1996) it has two classes of products –First, building which embraces housing, offices, hospitals, factories, e.t.c. Secondly, civil works which involve infrastructure, water supply, transport, irrigation, and so on. Hence the statistical authorities in Nigeria use the notation “Building and Construction” probably to capture the components of the sector.

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The important role played by the B&C sector in the economy can be measured by the direct and indirect impact it has on the national economy as it stimulates the growth of other sectors through a complex system of linkages. Obadan and Uga (1996) add that the B&C industry has a unique ability to facilitate development by providing directly for human needs or stimulating investment, or by generating employment which can accomplish these objectives. The sector is also a very important contributor to domestic capital formation and creator of wealth through its direct and indirect intersectoral multiplier effects. The B&C sector is different from all other sectors in the economy in a number of ways which affect the level of its productivity and output. In particular, the B&C industry is very susceptible to economic fluctuations which is supported by Lewis (2004) assertion that when the going is good, construction booms with rapid and high levels of growth of demand and when the economy experiences downturns, the B&C sector plummets.

In an attempt to present the macroeconomic review of the B&C sector in Nigeria between the periods under consideration, the paper is organized in five sections. Following the introduction, section 2 presents a review of the Nigerian economy performance through the decades. In section 3, the pattern of structural change and performance of the B&C sector over the period under consideration is examined while section 4 presents the problems and features of the B&C sector in Nigeria. The final section presents the conclusion and recommendations for policy.

## **NIGERIA ECONOMIC PERFORMANCE THROUGH THE DECADES**

The Nigeria economy over the decades has witnessed different economic climates among which include periods of economic decline, revival, boom, and crash. The National Bureau of statistics (2007) describe the economy as experiencing unsteady and sluggish growth. Ukwu, Obi and Ukeje (2003) also note that Nigeria is recognized as one of the most volatile economies in the world. Agriculture was the core economic activities in Nigeria in the 1960s to early 1970s, then, manufacturing and mining activities were at very low level of development while the country's participation in the external trade was informed by the level of activities in agriculture (FOS, 1996). However, since the emergence of the oil boom of 1973/74 and again in 1979-1980, Nigeria depends almost entirely on the production of petroleum. While oil wealth had financed major investments in the country's infrastructure, Nigeria remains among the least developed countries in the world in terms of per capita income and human development (see Table 1).

Table 1: Human Development Index (Country Total - 177) and GDP Per Capita @2005

Country	HDI Rank	GDP Per Capita (US \$)
USA	12	41890
China	81	1713
South Africa	121	5109
Nigeria	158	752

Source: Human Development Report 2007/2008

Adam and Busari (2003) observe that the government embarked upon import-substitution industrialization strategy in order to reverse the deteriorating trade balance and hasten industrial development before 1970s. This development encouraged private investment which made the private sector contribution, on the average to be twice that of the public sector. However, the oil windfall of the 1970s



changed the sectoral composition of the GFCF in favour of the government (Adam and Busari 2003). Sanusi (2002) notes that the oil boom of the 1970s brought in its trail some fundamental developments that had serious implications for macroeconomic management. These were the heavy dependence on the oil sector as the main source of foreign exchange earnings and government revenue and an extraordinary expansion of the public sector, and the unsustainable growth in government spending arising from the massive investment in social physical and economic infrastructure.

Nigeria went through the Structural Adjustment Programme (SAP) in the second half of the 1980 up to 1994 in an attempt to correct her deteriorating current account balance and to access additional international funding. However, SAP left the economy in a worse state than before its implementation. Ajayi (1996 cited in Oyediran 2003) opines that the economic environment in the 1980s and 1990s were certainly not as good as they were in the 1960s and 1970s with the additional effect of heavy external burden with debt overhangs which has done a lot to retard growth and development. Feng (2003 cited in Yusuf 2009) adds that democracy indirectly affects growth by introducing a predictable process of regime change. However, given the weaknesses of economic policies, growth in developing countries as in Nigeria was slower during 1980 to 2000 than it was during 1960 to 1980 despite the macroeconomic adjustment policies introduced in the former period.

The National Bureau of Statistics (2007) notes that Nigerian economy recorded a sluggish growth averaging about 2.62 per cent for the two decades, 1981-2000. However, since 2003, the economy has been experiencing appreciable growth. IMF (2008) adds that the implementation of prudent macroeconomic policies and ambitious structural reforms, supported by a favourable external environment, including high oil prices, has contributed to impressive performance since 2005. IMF further notes that the real GDP growth rose from 6 per cent in 2005 to a projected rate of 9.0 per cent in 2008; inflation declined, the exchange rate stabilized; and there has been strong fiscal and external position. IMF (2008) adds that notwithstanding the medium term prospect experience in recent times, significant challenges still remain including sustaining the high GDP growth, with low inflation, saving oil revenue and ensuring that the benefits of economic growth reach all segment of the population. Table 2 shows some macroeconomic indicators for Nigeria in selected years.

Table 2: Macroeconomic indicators for Nigeria in selected years

Year	Real GDP growth rate (%)	GDP per capita (US\$)	Annual Inflation rate %
1980	-4.9	1450	9.9
1985	9.4	1092	5.2
1991	4.7	367.4	13
1994	1.3	432	44.7
2000	5.4	359.8	9
2004	6	459.5	12.5
2006	5.6	882.5	12.6

Sources: Central Bank of Nigeria, World Economic Outlook: October 2007, Federal Office of Statistics 1996

## STRUCTURAL CHANGE AND PERFORMANCE OF NIGERIAN BUILDING AND CONSTRUCTION SECTOR

There exist a close relationship between growth in construction and changes in the gross domestic products (GDP) of various countries. A higher value of B&C sector in GDP implies larger contributions of the sector while a lower value denotes smaller contribution in the national economy. On the whole, the B&C sector in Nigeria is yet to make a significant impact on the economy by way of its contribution to GDP. The steady erosion of the B&C sector since the 1980s is a reflection of the neglect, dilapidated state and collapse of the Nation's physical infrastructure Table 3 indicates the contribution of B&C and other sectors in the economy to GDP in Nigeria 1960-2006.

Table 3: The changing structure of Nigeria's GDP, 1960 -2006 (%)

Period	Share of B&C in GDP (%)	Manufacturing	Agriculture	Mining and Quarrying	Other services
1960 -69	4.73	5.9	59	3.14	27.23
1970 -79	9.71	6.7	33.43	14.95	32.21
1980 -89	2.75	8.78	39.14	12.76	36.57
1990 -99	1.81	5	33.84	0.27	59.08
2000 -06	1.7	3.77	40.08	0.27	54.18

Sources: Federal office of statistics (1996) – Data for 1960 -1989

National Bureau of Statistics, October, 2007 – Data for 1990 -2006

In term of volatility Ukwu, et al (2003) observes that the pattern of volatility vary among the various sectors in the economy while in terms of GDP, the most volatile sectors are B&C; communication; and mining. The least volatile are distribution, transport and manufacturing. Table 4 show the variability Ratio of sectoral shares of GDP 1960-2000.

Table 4: Variability ratio of sectoral shares of GDP (1960-2000)

Variable	variability Index
Agriculture (Total)	34
Mining and Quarrying	65
Manufacturing	26
Utilities	55
Building and Construction	69
Transport	29
Communication	66
Distribution	23

Source: Ukwu, Obi and Ukeje (2003) p.11

Ayanwale (2007) observes that Nigeria, because of her natural resource base and large market size has benefited as a major recipient of foreign direct investment (FDI) in Africa. However, 60 per cent of FDI inflow in the country is made into the extractive (oil) industry while the other sectors received lesser attention. Table 5 shows the sectoral composition of FDI in Nigeria 1970-2001. Agriculture; transport and communication; and B&C remained the least attractive hosts to FDI. However, the

transport and communication sector have seem to have succeeded in attracting the interest of foreign investors especially in the telecommunication sector in recent years.

Over the period under study (Pre 1980-2006) significant events have taken place which made considerable impact on the Nigerian macroeconomic environment as well as the B&C sector performance. The following are highlights of some of these events and how the B&C sector reacted to the changes in the macroeconomic environment in Nigeria during these eras.

Table 5: Sectoral Composition of FDI in Nigeria, 1970-2001 (%)

Year	Mining and quarrying	Manufacturing	Agriculture	Transport and communications	B&C	Trading and business	Misc. services
1970-1974	51.2	25.1	0.9	1	2.2	16.9	2.7
1975-1979	30.8	32.4	2.5	1.4	6.4	20.4	6.1
1980-1984	14.1	38.3	2.6	1.4	7.9	29	6.5
1985-1989	19.3	35.3	1.4	1.1	5.1	32.6	5.2
1990-1994	22.9	43.7	2.3	1.7	5.7	8.3	15.4
1995-1999	43.5	23.6	0.9	0.4	1.8	4.5	25.3
2000-2001	30.7	18.9	0.6	0.4	2	25.8	21.5
1970-2001	30.3	32.2	1.7	1.1	4.7	19.1	10.9

Source: CBN Statistical Bulletin (Various issues) cited in Ayanwale (2007) p. 12

### Pre 1980: Independence and the oil boom era

Olowookere (1988 cited in Oyediran 2003) notes that the Nigerian construction industry contributed about 6 per cent of the GDP since 1960 when the country attained independence. Oyediran (2003) adds that the necessary foundation was laid for infrastructure development at this time despite limited financial resources. The contribution of the construction sector to GDP before 1981 stood at an average of about 8.61 per cent which compares with Well's (1987) values for rich countries. Adam and Busari (2003) also observe that B&C and related activities accounted for over one-half of the total investment expenditure in the 1960s. In 1966 the sector accounted for about 46 per cent investment expenditure while plant, machinery accounted for about 32 per cent. On his part, Isola (2005) notes that the B&C sector account for an estimated 62.7 per cent of GFCF rising to over 76.59 per cent in 1980. The civil war between 1965 and 1968 brought rapid decline to the economy which also resulted into an indescribable destruction of infrastructural facilities. However, the period of reconstruction that followed called for faster and more efficient construction agencies. The incidence of oil boom around the same period further created the best economic environment for the construction sector of the Nigerian economy.

The period of economic revival and oil boom which span between 1969 and 1980 witnessed the establishment of multinational construction companies in Nigeria. During this period there was increased demand for constructed facilities and there was easy access to loan for development. Other factors that boosted the B&C output according to Isola (2005) is the second and third National development plan which span between 1970 and 1974 in the first instance and 1975-1980 in the latter. These development plans had as its major focus, the development of infrastructure and the encouragement of the private sector to provide and finance housing for their employees. Also more than one-third of the public investment budget was actually allocated to the B&C sector at this time.

### 1981-1998: Economic downturn and reform era

The early 1980s witnessed a downturn in the economy, occasioned by the fall in the oil prices which resulted in low demand and lower investment in infrastructure. Oyediran (2003) observes that at this period there was a reduction in both public and private investment due to reduced revenue. Moreso, the Nigerian government failed to take advantage of the previous oil windfall in developing other sectors of the economy. As shown in table 3 the share of B&C to GDP experience steady decline since the early 80s. This poor performance of the B&C sector responded to the downturn in the economy. This negative effects support Lewis (2004) view that when the national economy does well, the construction industry does even better and when the economy slumps, so does construction, only more so.

The structural adjustment programme (SAP) introduced in 1986 had negative effects on the B&C sector. Ajayi (1996) was of the view that SAP altered the macroeconomic environment and also, brought about decline in the expenditure of social sector, thus defeating one of the major aims of the programme. In addition to SAP, the incursion of the military into politics further affect the construction sector negatively as little attention was paid to the development of infrastructure (e.g. road construction, bridges, housing) during their regime. Thus in the mid-1980s the trend in GFCF investment as a share of GDP fell sharply however in the early 1990s it started to rise again. During the period between 1981 and 1996 the average percentage contribution of B&C sector to GDP stood at 2.22 percent which depict the poor performance of the sector at this period (Federal office of Statistics, 1997).

The impact of the macroeconomic environment on the B&C sector can further be viewed by considering the sector contributions to employment. According to Fajana (1995) the low performance of the B&C sector between 1981 and 1991 affected the level of employment significantly. On the other hand, due to the economic recession of 1981-1984 mass retrenchment was experienced in almost all the sectors of the economy, albeit at different degree. Table 6 shows the distribution of total and retrenched employees (1982-1983) by industry. The most affected sectors are construction, manufacturing and processing, commerce, agriculture, mining and quarrying.

Table 6: Distribution of total and retrenched employees by industrial sector (1982-1983)

Industry	Percentage share of total employees	Percentage share of retrenched staff
Construction	3.4	37.3
Commerce	2.6	6
Manufacturing and Processing	11.2	24.7
Electricity, Gas and Water	1.4	0.2
Agriculture	4.9	2.4
Transport and Communication	18.1	2.9
Community, Social and personal services	52.9	17.6

Source: Fajana (1995) p. 44

### **1999-2006: Era of renewed growth and reforms**

The recent macroeconomic environment as revealed by macroeconomic indices of performance has not shown a complete revival of the economy (Oyediran, 2003). However, there abound evidences of a recovering economy. For instance, in 2003, 2004, 2005 and 2006, it grew by 10.23%, 10.48%, 6.51%, and 6.03% respectively in real terms (National Bureau of Statistics, 2007). Moreover, IMF (2008) notes that for the past few years Nigeria has experienced a regular annual growth rate of between 5 and 6 per cent as a result of the reforms launched and the implementation of economic development programmes. In addition, the return to democratic rule, with anticipated stable political environment injected confidence in investors which in turn help to boost the construction industry. However, the B&C sector's share of GDP remains very low. According to National Bureau of Statistics (2007) the contribution of the B&C sector to the national economy has reduced to a mere 1.5 per cent of the GDP in 2005 from 2.0 per cent on the average between 1999 and 2001. This contribution is far lesser than the sector contribution to GDP in the early to mid 1980s. This reflects the extent of neglect and the dilapidated state of the country's infrastructure. Nevertheless, despite the sluggish state of the economy the construction sector still contributed substantially to employment generation going by the amount of construction works undertaken in form of new town development and public utility works for education, health, and telecommunications in most cosmopolitan cities (e.g. Lagos and Abuja) within this period.

### **PROBLEMS AND FEATURES OF THE CONSTRUCTION SECTOR IN NIGERIA**

Tan (2002), Obadan and Uga (1996), and Olaloku et al (1976) identified structural problems which tend to hamper developing countries' efforts toward raising construction output, in which Nigeria situation is not an exception. These problems among others include: high import content of capital, labour, and materials that worsens the balance of payments; over - valued exchange rates, exemption from import duties and low interest rate policy that encouraged capital imports and capital intensive production; skills and materials shortage including management and entrepreneurial skills; inadequate finance and delays in payments; weak planning and administrative machinery; dominance of foreign contractors and inadequate local capacity on the part of indigenous contractors.

In addition to rising cost of inputs are the unfavourable conditions under which the construction companies in Nigeria carry out their works couple with inappropriate output targets set by planning authorities, resulting in irregular work flow, inefficiencies and poor quality of output; separation of design and construction that provides little incentive to reduce cost; and inappropriate regulatory framework (such as rigid qualifications and registration of contractors). Other limiting factors include poor maintenance and breakdown of infrastructure; power outages and instabilities in the energy sector; high rate of corruption among government officials; high rate of inflation which escalate prices of B&C materials; and lack of conducive business environment which ward off prospective foreign investors ( Ajayi, 1996; Obadan. and Uga, 1996; Adams,1997; Oyediran, 2003).

### **CONCLUSION AND RECOMMENDATIONS**

The principal factors affecting the performance of the construction industry among others include the status of demand and government policy actions. As in the case of

Nigeria (also a common feature of most developing countries), the public sector is normally the major clients for construction and their expenditure forms a major element of fixed capital formation. The demand for infrastructure has a close link with the demand for building and construction, thus the infrastructure base of the Nigerian economy has remained weak in the past decades. Since growth in the B&C sector is directly related to growth in physical investment coupled with its positive impact on the economy, it then becomes very imperative for the policy makers (especially the government) to intensify effort toward the development of a sustainable construction industry in Nigeria. To achieve this, access to credit by the private construction sector should be made available at reasonable interest rate in order to encourage their active participation in the provision of infrastructural facilities.

More over, the government being the major client of the industry should stimulate the sector through fiscal and monetary policies while the stock of existing physical infrastructure should be repaired and maintained in order to retain their economic value. A favourable economic climate that will attract foreign investors should also be created while the establishment of a proper regulatory framework for the construction industry technological development should be put in place in an effort to increase the B&C sector output above 5 per cent of GDP necessary for economic growth as in more developed economies.

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# THE ROLE OF CONSTRUCTION EDUCATION IN SUSTAINABLE WASTE MATERIAL MANAGEMENT IN THE CONSTRUCTION INDUSTRY: A STUDY OF BUILT ENVIRONMENT PROGRAMMES RUN BY TAMALE POLYTECHNIC

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Today's world requires sustainable waste management practices to ensure that principles of sustainability are followed during the construction of facilities that fulfil a variety of needs in society. The paper presents discussions on knowledge requirements in relation to sustainable waste management in construction alongside construction professional training in Polytechnics and the role they could play in sustainable waste management in the construction sector. Preliminary results of a pilot survey administered to a sample of 34 continuing students, 11 graduates employed in the construction sector and 7 teaching staff are presented. The results demonstrate that training does not adequately address key sustainable management practices such as design solutions to waste materials generation, recycling and sorting of waste materials. Also, graduates perceive this aspect of their role challenging with their training offering them little knowledge to solve practical problems bordering on issues relating to sustainable waste management. The paper concludes by calling for measures that will address the requirements of sustainable management of waste at the HND and BTech levels of polytechnic education in Ghana.

Keywords: academic programme, construction education, Ghana, sustainability, waste management.

## INTRODUCTION

Waste remains one of the greatest challenges facing humanity in the twenty first century as more attention is given to issues relating to sustainable development. Increasingly, the harmful effects of waste produced by industrial sectors on the environment have drawn the attention of policy makers and researchers in both developed and developing countries (Bossink and Brouwers 1996). The construction industry is one in which significant amounts of waste are generated (Formoso et al. 2002; Poon et al. 2004) which have deleterious effects on the health and safety of persons as well as the environment. Bossink and Brouwers (1996) report waste levels of 15-25% common in the literature pertaining to construction industry's contribution to industrial waste. Common waste generated by the construction sector include; solid waste such as concrete, brickwork, stone, metals (particularly steel), timber and glass. These wastes are generated in workshops where work is being prepared for

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construction sites, at construction sites and by the activities of the consumers of construction products.

Generally, waste is a by-product of industrial and consumption activities. Increasing industrialisation and urbanisation characterise developing countries (Hämäläinen et al. 2006). Industrial waste is therefore likely to increase in parallel with the pace of industrialisation particularly in urban centres in these countries. Arguably, the quantity of construction wastes in these countries is likely to increase with their effects on the health, safety of the populace as well as the environment reaching abysmal levels if the construction sector fails to adopt sustainable construction practices. Ghana is one of the few developing countries believed to be on track in achieving the Millennium Development Goals (MDGs) in attaining a middle income country by 2015. However, this progress can be greatly impeded if adequate measures are not taken to reverse the rate at which the construction industry generates material waste through inappropriate sustainable waste management practices. Whilst attaining a middle income status by 2015 will require huge injections of capital in the area of urban infrastructure, maximum benefits can be realised only if such development is in accord with sustainable development principles.

Education provides skilled human resource in both developing and developed countries which is required to effectively manage waste generated by human population, consumption and technology. To date the corpus of literature has highlighted the role of educational institutions in sustainable waste management. However, there is a paucity of literature on the extent to which sustainable waste management is incorporated in the main activities of higher learning institutions namely; teaching and research particularly in developing countries. It is necessary that construction engineers and managers trained by educational institutions are equipped with the requisite know-how to face challenges relating to waste management issues in today's world. In regard, the overarching aim of this study is to examine the role polytechnic education plays in sustainable management of waste in the construction sector with specific focus on Building Technology programmes in Tamale Polytechnic. The specific objectives of the study are as follows:

- to examine the relevance of professional training provided by Tamale Polytechnic in relation to sustainable construction waste management; and
- to make recommendations for improving the capacity of graduates in the Building Technology discipline in sustainable construction principles.

## **BACKGROUND AND CONTEXT**

The construction industry plays an important role in the provision of infrastructure in both developed and developing nations. The products of the industry range from large infrastructural projects such as; roads, bridges, dams, mass housing, waste facilities to institutional buildings, shopping malls, warehouses and single dwelling houses. The association between infrastructure and economic growth has been well documented in the literature (Anaman and Osei-Amponsah 2007). Alongside the contribution of the industry to economic growth, it negatively impacts upon the environment through depletion of non renewable resources, land use and waste it generates. Construction waste remains the responsibility of clients, consultants, and contractors and therefore requires adequate knowledge and technical expertise on their part to effectively manage waste. In this regard construction educators have a role to play in ensuring

that sustainable construction and waste management practices are adequately addressed in teaching and research.

### **Material waste in construction**

Many authors attribute material waste generation by construction and demolition activities to factors that include design, take-off/specification, delivery and site operations (Cooke and Williams 2004; Craighill and Powell 2003; Ekanayake and Ofori 2000; Illingworth 2000). Ekanayake and Ofori (2000) identified design changes as a major cause of material waste generation on construction sites in Singapore and suggest effective management of waste at the design stage as key to minimising material waste generated on construction sites. However, significant factors that contribute to material waste on construction site may vary considerably from one country to another depending on local conditions. The management of material waste generated by the construction sector needs to be done in a manner to ensure efficiency in the production process and sustainability of the scarce primary materials while minimising environmental hazards.

### **Sustainable waste management**

Sustainable waste management has the goal of reducing the quantity of waste generated, reusing waste materials in construction and renovation and recycling waste by processing waste that is generated for use in construction and renovation works (Edum-Fotwe and McCaffer 2007; Masood et al. 2002). This has often been summarised in the waste management literature as the 3Rs; Reduction, Reuse and Recycling.

Reducing material waste on construction sites requires prudent management practices. Materials have to be ordered in the right quantities and material handling should be such as to minimise waste on site. Material control procedures must be put in place and closely managed. It is essential to reduce the use of non-renewable materials and where possible they should be substituted with secondary resources such as materials reclaimed after construction or demolition activities. Emissions into the atmosphere resulting from construction and demolition activities should be reduced to tolerable levels.

Heavy reliance on the use of primary construction materials such as timber, river sand, quarry chippings etc for construction and other related activities ultimately leads to high rates of depletion of these natural resources unless appropriate measures are taken to control the rate at which they are extracted. Alternative sources which could serve as substitute to these materials involve the use of non-primary materials

Recycling in construction will involve sorting of material wastes produced on sites into their constituents and processing of the base constituents using appropriate recycling equipment. Where possible sorting of materials and processing should be done on site to facilitate re-use and minimise generation of waste and demand for primary materials.

Life cycle assessments (LCA) of methods of managing construction material waste by Craighill and Powell (2003) suggest reuse of material waste as the lowest overall environmental and social impact, followed by a combination of reuse and recycling, with landfill disposal the least desirable option. It should however be noted that only small proportion of construction materials waste is used to replace primary materials. This leaves a combination of recycling and reuse as the more practicable option of

sustainable management of construction materials waste. Recycling has a disadvantage over reuse since the process involves consumption of energy,

### **Construction education**

Changing regulation, environmental concerns and competition are key issues in material waste management in the construction industry worldwide. These challenges make it imperative for construction engineers and project managers to continually acquire technical and managerial skills on more innovative ways of addressing these issues than their traditional training can offer. Clearly, this need calls for a re-evaluation of the technical and managerial know-how of construction professionals and re-examination of existing programmes. Edum-Fotwe and McCaffer (2007) have emphasised the need for additional skills and knowledge beyond the technical requirements of basic academic training of construction professionals.

Polytechnics in Ghana play a significant role in the provision of skilled manpower needs of the country (Aidoo-Tailor 2009:43-49; Owusu-Agyeman and Oosterkamp 2009:51-65). To date, there are many challenges to realising the aims and objectives of polytechnic education as contained in the White Paper establishing polytechnics in Ghana. Owusu-Agyeman and Oosterkamp (2009:59) have documented challenges to the Ghanaian Polytechnic educational system as including quality and relevance of curricula and argued for continuous update and evaluation of the various course contents to reflect social and technological development. Clearly, HND Building programmes run by polytechnics in Ghana suffer from lack of proper design of course contents. Arguably, the implementation curricula are likely to have serious setbacks on the competence of graduates in the discipline vis-à-vis their ability to cope in a changing technological world.

## **METHODS**

### **Questionnaire development**

Draft questionnaires were developed and piloted among teaching staff of the school of Engineering–Tamale Polytechnic. Suggestions made were incorporated and final versions of the questionnaires were administered to lecturers, students and graduates of the Building Technology Department of Tamale Polytechnic. The final questionnaires developed and used for the three categories of respondents in the study comprised questions with fixed response categories and open-ended questions.

The questionnaires developed contained two sections (Section A and Section B). Section A solicited responses on personal particulars and personal information such as name, telephone number, experience (for the questionnaire administered to lecturers), type of sponsorship (questionnaire administered to students) and type of organisation the respondent is employed in (questionnaire administered to students and graduates). Section B asked questions on sustainable construction and demolition waste material management practices and suggestions on how teaching and learning in Ghanaian polytechnics could enhance training in sustainable construction and demolition waste material management.

### **Sampling**

All fifteen staff teaching courses in the Building Department were supplied with the questionnaire designed for lecturers. All final year students (35) pursuing HND Building Technology were given the questionnaire designed for students. Whereas as many as 219 students have successfully completed the HND Building Technology

programme run by Tamale Polytechnic, only few are known to be employed in the construction industry. The researcher contacted graduates working directly in the construction industry and those in technical departments of organisations that require the services of construction professionals in the Northern Region. The latter organisations included Ministry of Health, Architectural and Engineering Services Limited, Public Works Department, Organisations providing consultancy services in construction and architectural services, building material suppliers, District, Municipal and Metropolitan assemblies.

### **Procedure for analyzing results**

The data obtained was analysed using descriptive statistics. This enabled responses to be categorised and the summarised data presented in tables and a figure. Respondents' opinions on sustainable construction and demolition waste material management practices were analysed using relative importance index (RII) (Kaming et al. 1996) given as

$$RII = \frac{4m_1 + 3m_2 + 2m_3 + m_4}{4(m_1 + m_2 + m_3 + m_4)}$$

Where  $m_1$  = number of respondents who rate the item (sustainable measure) as 'very important';

$m_2$  = number of respondents who rated 'important';

$m_3$  = number of respondents who rated 'somewhat important'; and,

$m_4$  = number of respondents who rated 'not important'.

## **RESULTS**

### **Respondent characteristics**

Thirty-four out of a total of 35 final year HND Building Technology students completed the questionnaires and submitted. Efforts to contact the student who failed to submit the questionnaire which was given to him proved futile. Thirteen students (37%) said they were responsible for payment of their fees and living expenses while on campus while 17 (49%) said their guardians were responsible for all expenses in connection with their education. Three said their employers sponsored their education and one student indicated that apart from his guardian catering for expenses in connection with his education he also made significant contribution. When asked about their employment history, 11 said they were working with Ghana Education Service, 5 said they were working in family business, 3 indicated they were working with construction businesses, 1 worked with an NGO and the other with Ghana Prisons Service. The age distribution of the respondents is given in Figure 1 below.

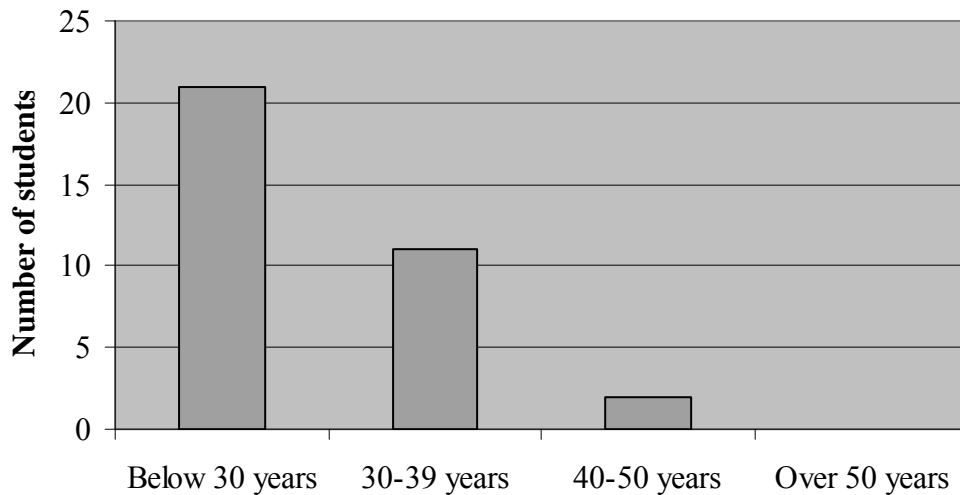


Figure 1 Age distribution of students

Twenty-one of the students said they obtained the Senior Secondary School Certificate, 9 had Construction Technician Course Certificate, 2 Ordinary Technician Diploma certificate and 1 student said he had Full Technological Certificate.

Responses from 12 graduates were obtained out of which 11 were useable. In all 17 graduates were reached indicating a response rate of 65%. Key graduates in the Tamale Metropolis and in municipalities and District capitals co-ordinated the data gathering process thus enabling the response rate of 65% to be achieved. However, there is no certainty that the 17 graduates contacted are the only graduates of the Building Technology Department of Tamale Polytechnic employed in the relevant organisations covered in the study. The age of the respondents ranged from 30 to 39 with the mean number of years of working experience of 6. Majority of the respondents (8) were working at construction sites as site supervisors and the rest (3) working in the estates departments in the organisations they were employed. The highest level of educational qualifications attained was HND although three were enrolled for a bachelors degree programme through distance education mode.

Seven teaching staff completed the questionnaires and submitted. Efforts to get the rest to complete and submit the questionnaires they were given was unsuccessful. Two of them gave reasons of tight schedule as the reason for failure to complete and submit the questionnaire within the deadline for submission. The rest (6) did not advance any reasons for their failure to submit. The length of experience ranged from 5 to 14 years with majority aged between 40 to 49 years. The courses taught at the HND level by the respondents include the following:

- site organisation procedures;
- building maintenance;
- Building services;
- Project planning and control;
- Technical report writing;
- Construction technology;
- Strength of materials
- Building materials;

- Building management; and
- Environmental impact of construction activities.

Given the experience of this category of respondents the responses to questions could therefore be considered as true and accurate reflections of teaching and learning relating to sustainable construction and demolition waste material management.

### **Training in construction and demolition waste materials management**

All the graduates agreed that their training does not address waste materials management at the design phase with some indicating that aspects relating to recycling and sorting of waste materials are not adequately addressed by their training (Table 1). The most widely adopted waste management practice is reuse (10) and disposal at landfill (8). Four said they ensure strict supervision on site to minimise waste materials generated on site and 2 said they dispose off waste materials by incineration. These responses should be treated with caution as there can be a tendency for respondents to project a positive image about their employers.

Table 1. Graduates' perceptions of the extent to which their training addresses key waste management issues

<b>Key waste management issues</b>	<b>Does not address it</b>	<b>Addresses it</b>
Effects of construction and demolition waste materials on the environment.	0	11
Causes of construction and demolition wastes materials on project sites.	0	11
Cost of construction and demolition waste material on construction sites.	0	11
Reuse of waste materials arising from construction and demolition activities.	0	11
Recycling of waste materials arising from construction and demolition works.	2	9
Sorting of waste materials arising from construction and demolition works.	3	8
Minimising waste materials arising from construction and demolition works.	0	11
Addressing waste materials arising from construction and demolition works at the design stage.	11	0
Handling of waste materials arising from construction and demolition works.	0	11
Disposal of waste materials arising from construction and demolition works.	0	11

The third year students' responses on the extent to which their training address waste management issues are summarised in Table 2. Clearly, many of them regard their training as not addressing the same issues named by the graduates namely; design solutions to waste material generation, recycling and sorting of waste materials. This is a rather surprising result given that the course content of the HND Building Technology syllabus was considerably revised and adopted in the year 2000.

### **Importance of measures to address waste materials arising from construction and demolition works**

Views of graduates and teaching staff on the importance of measures in addressing waste materials arising from construction and demolition works indicate that regulation and enforcement activity are very important measures in the effective management of materials waste on construction sites. While graduates rank regulation and enforcement activity as first and second respectively, teaching staff rank these as first and third respectively (Table 3). Measures relating to design and project team

efforts are equally important as can be seen from the ranking of the graduates and teachers. This is an interesting result given that both students' and graduates' responses suggest that their training does not adequately address issues relating to design solutions to material waste on construction sites.

Table 2. Students' perceptions of the extent to which their training address key waste management issues

Key waste management issue	Does not address it	Addresses it
Effects of construction and demolition waste materials on the environment.	2	29
Causes of construction and demolition wastes materials on project sites.	1	31
Cost of construction and demolition waste material on construction sites.	0	34
Reuse of waste materials arising from construction and demolition activities.	1	32
Recycling of waste materials arising from construction and demolition works.	23	9
Sorting of waste materials arising from construction and demolition works.	22	11
Minimising waste materials arising from construction and demolition works.	1	32
Addressing waste materials arising from construction and demolition works at the design stage.	21	8
Handling of waste materials arising from construction and demolition works.	5	29
Disposal of waste materials arising from construction and demolition works.	0	34

Storing and transporting materials properly within the site and ordering the right quality and quantity of materials are ranked low as measures to address material waste. With the exception of a few measures to address waste materials on construction sites there appears to be high degree of concordance in the two set of rankings. Significant differences in rankings relate to measures on assessing the level of waste generated during construction and demolition works with a view to finding remedial measures and using principles of modular coordination and prefabrication where the rankings differ significantly.

### **Suggestions for enhancing training in sustainable construction and demolition waste material management**

Suggestions on how teaching and learning in polytechnics could enhance training in sustainable construction and demolition waste material management are categorised into two; one set relating to practical training and the other course content. Suggestions bordering on practical training include; allocating more time to practical periods particularly during long breaks at the end of second semester, effective supervision and ensuring industrial attachment with the right organisations. The second set of suggestions for enhancing training in sustainable waste materials management relate to reviewing the course content for the HND to bring it in line with modern construction practices vis-à-vis principles of sustainable construction and demolition waste materials management. For instance, the syllabus could be reviewed



to address specific waste management issues, modes of lecture delivery such as audio visual means most amenable to presenting case studies on sustainable waste materials management. Also, lecturers need to pursue continuing education and professional development to attain the requisite level of skills and competence in handling sustainable construction and demolition waste materials management and related courses.

Table 3. Importance of measures in addressing waste materials arising from construction and demolition works

Measure	Graduates		Teaching staff	
	Index	Rank	Index	Rank
Regulations on management of waste materials arising from demolition and construction works.	0.82	1	0.86	1
Implementing quality control measures for materials and construction site practices.	0.77	3	0.82	2
Strict enforcement of laws governing generation, management and disposal of waste materials.	0.80	2	0.79	3
Assessing the level of waste generated during construction and demolition works with a view to finding remedial measures.	0.66	8	0.69	6
Project team efforts at effectively managing waste materials generated on construction and demolition sites.	0.75	4	0.75	4
Minimising design changes during the construction of facility.	0.73	5	0.71	5
Minimising design errors at the design phase of a construction project.	0.73	5	0.64	7
Using principles of modular coordination and prefabrication.	0.70	6	0.75	4
Ordering the right quality and quantity of materials for use on a project.	0.68	7	0.61	8
Storing and transporting materials properly within the site.	0.64	9	0.57	9

## DISCUSSION

The results presented suggest that the scope and depth of training provided at the HND level is not sufficient to equip graduates with the requisite skills and technical know-how to find solutions to waste materials management when working in industry. Also, the results suggest key measures that should be implemented for effective sustainable construction and demolition waste materials management. These issues are discussed in the sections that follow.

### Regulatory and institutional framework

The results suggest regulations on materials waste management and functioning institutional arrangements for enforcing regulations as measures required for effectively managing waste materials generated by the construction industry. Unfortunately, in Ghana there are no specific regulations to address waste materials

generated on construction and demolition sites in the country. However, the Environmental Sanitation Policy of the country contains broad guidelines on waste management. While this law, is of relevance to the management of construction and demolition waste, it does not address specific issues relating to recycling, reuse and minimisation of construction and demolition materials waste. The main institutions responsible for waste management in Ghana are the Ministry of Local Government and Rural Development and departments under it (metropolitan, municipal and district assemblies). Regulatory authority is vested in Environmental Protection Agency under the Ministry of Environment Science and Technology. These institutions are constrained by inadequate funding and lack of logistics to carry out enforcement activity and to effectively manage waste in general.

### **Implementing quality control measures for materials and construction practices**

The results provide evidence to support the need for quality control measures to control the amount of material waste generated by construction and demolition. This result accords with past research findings on the causes of material waste. For instance, Masood (2002) suggests that implementing quality control could significantly reduce the amount of waste produced in operations involving concrete. Additionally, many authors of quality management systems argue that their implementation in construction will result in efficiency (Gibb and Ayoade 1996; Harris and McCaffer 2006).

### **Design changes and project management team**

Adequate planning at the design phase of a project alongside detailed specifications will aid in the ordering of materials and use of quality materials in the right quantities during the construction and demolition phases. Clearly, this will avert possible rework during site operations and thus reduce the consumption of materials and other inputs thereby reducing materials waste on site. Frequent design changes are the result of poor planning and could lead to increased cost and large quantities of waste materials on a site. The project team has a role to play in ensuring that the quality of the finished project is acceptable and the client gets value for money invested.

Waste management plans and accurate records on waste materials should be considered at the early phases of a project. Project team members need to be aware of their responsibilities regarding the management of waste materials generated on site. Also, principles of sustainability (the 3Rs) need to be embodied in the design of the project.

### **Suggestions for improving teaching and learning in materials waste management**

The results suggest some gaps in the training of construction professionals at the HND building technology level. These gaps are partly as a result of the many challenges facing the country's polytechnic education as highlighted in the literature (Owusu-Agyeman and Oosterkamp; 2009) and continual change involving varying technologies, working conditions and coordination of different interdependent trades that characterise the construction industry (Laukkanen 1993). To address these gaps the following suggestions based on the study's findings are presented:

- reinforce student training by updating the present HND Building Technology Syllabus to make it relevant to sustainable waste management and related issues;

- encouraging practical training on construction sites and monitoring students on practical training;
- promoting lecturers' and instructors' participation in continuing education and professional development courses; and,
- promoting research on cutting-edge issues relating to sustainable construction and waste materials management.

## CONCLUSION

The scope of competencies provided by academic training in the Polytechnic studied for students pursuing HND Building Technology are not adequate for students and graduates to develop the necessary skill level required to address waste management problems encountered on most construction sites. In the light of this, staff involved in teaching courses need to extend their breadth of vision regarding competencies required by graduates of Building Technology Department. The findings of the study have important implications for making policy decisions on course contents by regulatory bodies namely; National Accreditation Board (NAB), National Board for Technician and Professional Examinations (NABPTEx), National Council for Tertiary Education and Conference of Rectors of Polytechnics.

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# THE ROLE OF ORGANIZATIONAL LEARNING IN ACHIEVING SUSTAINABLE CONSTRUCTION PROJECT DELIVERY

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The concept of organisational learning is receiving an increasing amount of attention in construction management research and practice. The importance of organisational learning is its potential impact on the improvement of organisational performance. The construction industry is of high economic significance and its projects have strong environmental and social impacts. There is need for sustainable change in the construction industry and the ability of construction organisations to cope with such change requires organisation learning. However existing organisational learning methods in the industry such as post project review and post occupancy evaluation do not assess the completed project against the triple bottom line, as they focus on technical issues. The general area of investigation in this on-going PhD research is organisational learning and project sustainability in the construction industry. It explores the issues of organisational learning and maturity levels at which construction organisations can deliver sustainable projects. It reviews relevant literature and presents initial results from a pilot study that interviewed experts in the industry to explore the state of the art in practice. The research shows that, there is a need in construction management research to further explore the link between organisational learning and sustainability; little research has been done linking organisational learning and sustainability in the construction industry. The research therefore identifies the need to develop a framework for implementing organisational learning for sustainable project delivery. The paper concludes by setting out a design for further work in this area.

Keywords: organisational learning, post project review, post occupancy evaluation, sustainability.

## INTRODUCTION

There has been an increased interest in organizational learning within the construction industry since the Latham (1994) “constructing the team” and Egan (1998) “rethinking construction” reports. In this current climate of economic volatility and uncertainty, many construction organizations are striving to survive and remain competitive. The construction industry is very important to the UK national economy; however, it is believed to have low productivity and poor performance. The key to company survival and prosperity is organizational learning (Chan et al. 2004); however, the construction industry is perceived to be slow to implement new management and technological approaches as compared to other industries.

Barlow and Jashapara (1998) believe that, people involved in construction projects are not given the opportunity to feed the experience they have gained back into future

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projects. These experiences get lost due to the fragmented nature of the organizational structure of the construction industry. Organizational learning improves organizational performance (Lopez et al. 2005; Kululanga et al. 2001) however construction as a project based industry is facing the problems in embracing organizational learning (Chan et al. 2004)

The relation between sustainable development and the construction industry has become clear, since construction is of high economic significance and has strong environmental and social impacts (Sev 2009). Implementing sustainability in an organization necessitates organizational learning. It is the key element of any effort to effectively implement sustainable development in organization (Siebenhuner and Anold 2007) In order to address the triple-bottom line of sustainability, construction organizations have to learn to adapt to environmental changes and economic opportunities, with organizational level learning is the primary vehicle for the achievement of the Brundtland (1987) sustainable development agenda in terms of meeting the needs of current and future generations (Porter 2008)

This paper explores the link between organizational learning and project sustainability in the construction industry. The first part of the paper reviews literature on organizational learning, organizational maturity, organizational learning methods in construction and sustainability. The second part of the paper presents the research questions, the aim and objectives, and the research design and methodology for the on-going PhD study. The final part of the paper concludes with the findings from interviews conducted with experts in the field of sustainability and construction management to explore the state of the art in practice.

## **LITERATURE REVIEW**

### **Organizational Learning**

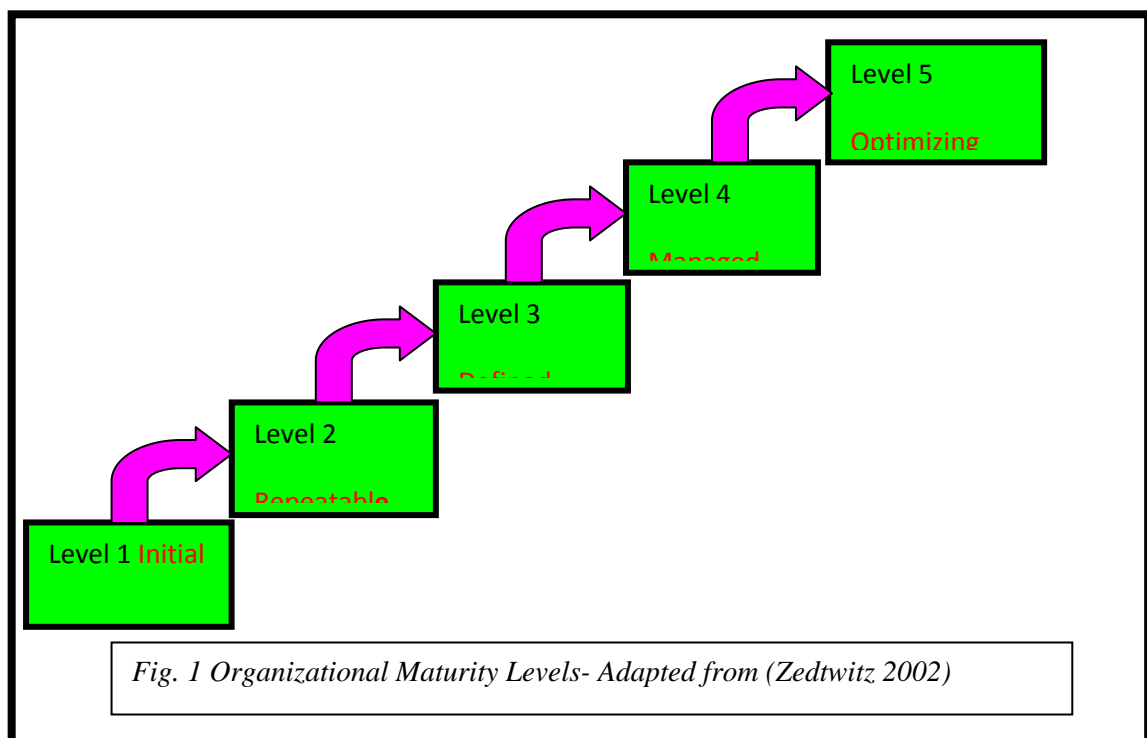
Organizational learning was defined as “the detection and correction of error” (Argyris and Schon, 1978) cited in (Fuller et al. 2007); however organizational learning needs to go beyond detecting and correcting errors. Organizational learning can be described as a dynamic process of creation, acquisition and integration of knowledge aimed at the development of resources and capabilities that contribute to organizational performance (Lopez et al. 2005). The significance of organizational learning is that it can improve organizational performance. Organizational learning is widely acknowledged as holding the key to companies’ survival and prosperity.

Pemberton et al. (2001) pointed out that, organizations develop new knowledge and core competencies in order to gain competitive advantage through organizational learning. Organizational learning is very important for creating and sustaining competitive advantage. Organizational learning is the effective way of making use of past experience and adapting to environmental changes (Berends et al. 2003). It is argued that most successful organizations develop effective learning processes at all levels of their organization. Due to poorly developed or inappropriate knowledge acquisition systems in the construction industry, knowledge and experiences gained by many firms are at the individual level and not at the organizational level (Barlow and Jashapara 1998) Organizational learning should be a restoration process of changing behaviours to enable an organization to achieve change as well as growth (Murray and Chapman 2003) Organizational change in the world today is so fast and prevalent that, if organizations fail to keep pace through learning, they will not survive (Chan et al. 2004) Organizations now consider learning as a more critical variable

than it used to be, due to the changing nature of work today (Thomas 2006) Organizations can change beliefs and adjust their regular pattern of behaviour through feedback (Hong 1999) Learning is described as the process of adjusting behaviour in response to experience (Law and Chuah 2004). The ability of organizations to effectively process information and influence various organizational actions is fundamental to the process of organization learning. The construction industry is at the forefront of the sustainable change agenda and the ability of construction organizations to cope with such change requires organizational learning. To succeed in the sustainable development concept, organizations have to engage in learning (Muller and Siebenhuner 2007).

### Organizational Maturity

The ability of an organization to engage in learning is influenced by its level of maturity. Organizational maturity level determines how organizations change and improve over time and incorporate lessons learned (CMU 1994). A maturity model provides an organization with the support and guidance necessary to evaluate their performance today and identify the next steps forward in realising their capabilities. It shows the extent to which project-based organizations clearly and constantly set out processes that are documented, managed, controlled and continually improved. A mature process passes through an unstable stage to a stable stage, to enjoy improved capability (Cooke-Davies 2004) Organizations differ in their ability to perform organizational learning processes (Muller and Siebenhuner 2007) As an organization increases in maturity, it shows more improved results (Cooke-Davies 2004) An organizational maturity model for evaluating the effectiveness of an organization's processes is organized into five levels namely; Initial, Repeatable, Defined, Managed and Optimizing as shown in fig.1 below



### Organizational learning methods in construction

The construction industry engages in organizational learning through post project reviews (PRR) and post occupancy evaluation (POE). Post project review is one of the

most commonly used approaches for passing on previous experience to enhance future project and organizational practice (Zedtwitz 2002; Cushman and Conford 2003) Organizational learning involves an organization's ability to reflect on its past experience to modify its future thinking (Chan et al. 2004) The engagement in project reviews and the application of lessons learned provides a mechanism for organizational learning (Kululanga and Kuotcha 2008)

Lessons learned should be documented and fed back into the organization. Project review is an important organizational learning process. It facilitates continuous learning on all levels within an organization. It is recommended that, a solid post project review practice should be part of a construction organization's learning processes (Zedtwitz 2002)

Post occupancy evaluation (POE) helps in obtaining feedback on recently completed construction projects from people involved in the construction process, occupants and other end users. However, POE which is very significant in the sustainable process is severely underutilized as sustainability continuous to grow as a priority in the construction industry (Mendler 2007). Lessons learned from POE can be used to improve the process and the design of future construction projects. The most important function of POE is to feed forward the learning of lessons obtained from the review of completed projects into future projects (Carthey 2006)

POE has the potential for supporting "double-looping learning" (Argyris and Schon 1978); that is to reflect on whether goals need to be reconsidered as well as evaluating how to achieve existing goals better. The use of POE contributes to the reduction of environmental impacts, increased economic viability and high client satisfaction in the construction industry (Kaatz et al. 2006)

Organizational learning methods in the construction industry such as post-project review (PPR) and post-occupancy evaluation (POE) focus on technical issues (OGC 2007; Zedtwitz 2002) and do not review completed projects against the triple-bottom line of sustainability; environmental, social and economical impacts.

### **Sustainability and Organizational Learning**

Sustainable development is rapidly being accepted across the world as the effective way of addressing the social, economic and environmental concerns. Sustainable development balances environmental resource protection, social progress and economic growth and stability now and for the future. Sustainable development has been defined in many ways but the most widely accepted definition is:

*"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" - From 'Our common future' (The Brundtland Report, 1987)*

The construction industry has a significant social responsibility to minimise the damage its projects do to the social environment. Sustainability at the organizational level refers to meeting social and environmental needs in addition to the firm's profitability (Porter 2008)

Sustainable construction is the application of sustainable development principles in the construction industry. Sustainable construction aims at reducing the environmental impact of a building over its entire lifespan, providing safety and comfort to its occupants and at the same time enhancing its economic viability. The construction industry recognises sustainability as a key factor in the success of a project and that performance through the supply chain is, key to this achievement. Sustainability in



construction has become a core issue and it is considered as one of the key vehicles for the successful completion of construction projects (Schultman and Sunke 2007) It is believed that the implementation of sustainability in any organization necessitates organizational learning (Siebenhuner and Anold 2007) Organizations that ignore and do not turn sustainability issues into competitive advantage are likely to become less effective. Learning and development processes are believed to be an important path towards the sustainable development agenda (Muller and Siebenhuner 2007)

Construction organizations are required to integrate the concept of social and environmental concerns in the operations; however this can only be achieved through the acquisition of knowledge on the sustainability concept to develop relevant solutions and standards through learning (Muller and Siebenhuner 2007) Progress towards more sustainable construction requires both government and individual organizations to take action (Holton et al. 2008)

Construction organizations are being urged to learn and engage in new ways of working in order to compete in the current business environment where sustainability is at the heart of the industry (Siriwardena and Kagioglou 2005). With the increasing demand for sustainable product and services, construction firms should position themselves in order to demonstrate the ability to deliver and tender for works (Cushman et al. 2002)

## **RESEARCH QUESTIONS**

The research therefore addresses the following key questions:

- What is organizational learning in construction
- Does the maturity level of an organization influence its learning capacity?
- How can organizational learning promote sustainability in construction?

## **AIM AND OBJECTIVES**

The aim of this research is to develop a framework for managing organizational learning for sustainable project delivery by construction organizations at different levels of maturity. The research contributes towards the understanding of organizational learning and sustainable project delivery in construction.

To achieve this research aim, the following specific objectives need to be addressed:

- review the current knowledge on organizational learning in construction
- critically examine the key features of organizational learning methods in construction
- explore the key features of sustainable construction project
- identify and discuss organizational maturity levels for sustainable project delivery in construction
- develop a framework for organizational learning in the delivery of sustainable construction.

## **RESEARCH DESIGN AND METHODOLOGY**

This research will adopt a pragmatic philosophical stance. Pragmatism is an epistemological position where one believes that the meaning of an idea or a proposition lies in its observable practical consequences. The pragmatic approach to research involves mixing data collection methods and data analysis procedures. (Creswell 2003) The research therefore employs both quantitative and qualitative

methods that match the specific research questions. Hence the pragmatic paradigm includes tools from both positivist and interpretivist tradition.

Hunt (1991) argues against the use of both qualitative and quantitative methods in the same research, because it is asserted that the two paradigms differ epistemologically and ontologically. However many researchers believe that combining qualitative and quantitative methods (Triangulation) can increase the in-depth understanding of the phenomenon under investigation as well as increase in the credibility of scientific knowledge (Bryman 2004; Creswell 2003; Tashakkori and Teddlie 2003)

Triangulation is the combination of two or more methodological approaches, theoretical perspectives, data source and data analysis methods to the study of the same phenomenon. It is a robust and rigorous means of ensuring the use of a mixed method approach.

The first phase of the research is to extensively examine existing literature on organisational learning and sustainability in construction. It will be supported by empirical data drawn from a variety of sources including questionnaires, pilot study, interviews and case study, which will seek respondents from the construction industry in the UK. Questionnaire and interview techniques will be adopted for primary data collection. The motive to use a questionnaire is the ability to reach a large target group in a practical and efficient way. A pilot study will be used to test the quality, clarity, time scale and bias of the questionnaire (Naoum 2002) Interviews are useful to obtain detailed information about personal feelings, perceptions and opinions.

The presence of data is an essential part of every empirical research. Data were collected for this paper through an exploratory pilot study; this approach is best used when the research problem to be investigated is at the preliminary stage. A pilot study was conducted by interviewing practitioners in the field to explore the current state of practice in relation to organizational learning, organizational maturity level and sustainable practices in project delivery processes.

## **DATA COLLECTION AND DISCUSSION**

This exploratory pilot study sets out to explore the state of the art in practice for organizational learning, and sustainable project delivery in the construction industry. In this paper, the term pilot study is used to mean a feasibility study or trial run carried out in preparation for the main study. It is a means of gathering primary data to support the suspected research gap in literature.

In addition, a pilot study is undertaken at the early stages of a research study as means of convincing funding bodies, stakeholders and academia that, the proposed research is worth supporting (Teijlingen Van and Hundley 2001)

This study seeks to engage experts in the field of sustainability and construction management processes to explore the state of the art in practice for organizational learning and sustainable project delivery.

This exploratory pilot study was conducted by interviewing five (5) visiting professors to the school of Built Environment (SoBE), University of Salford, who were drawn from practice and industry. These visiting professors are experts in the field of built environment, with background in contracting, social housing and regeneration, academia and consultancy organisations. The interviews were conducted in a loose structure lasting 15-20 minutes.

The qualitative data collection established the relevance of post project review and post occupancy evaluation in achieving organizational learning in the construction industry. It was also conducted to explore if sustainability is currently a key criterion in the above learning methods.

The first interview question asked the usefulness of post project review and post occupancy evaluation in achieving organizational learning in the construction industry. It was found that all the interviewees were in agreement that post project review and post project evaluation are very useful for the achievement of organizational learning in construction. As interviewee 2 put it;

*"Very useful, there is a substantial lack of feedback from completed projects to the teams developing the preliminary phases of new projects"*

When respondents were asked if sustainability should be considered a key criteria in post project review and post occupancy evaluation, it was found that the interviewees supported the view that, sustainability should be a key criteria in the above construction industry organizational learning methods. However interviewee 5 commented that;

*"Yes, sustainable development is now at the top of the agenda in the industry of the built environment, because this industry uses 40% of the energy used by man and generates 40% of the waste generated by man. It is the key industry to address and engage the improvement of the sustainable presence of man on the planet"*

Contrary to the above, some respondents were of the view that, sustainability should be an issue that is only considered at the beginning of the construction process. When probed further, interviewee 1 responded by saying;

*"Sustainability comes at the beginning of the construction process and re-evaluated at the end of completed project"*

There were mixed responses when interviewees were asked about the importance of an organization's experience or level of maturity in achieving organizational learning to deliver sustainable construction projects. Some of the respondents believed strongly that there was a link between organizational maturity or organizational experience and achieving organizational learning to deliver sustainable construction project. One respondent argued that, organizational maturity or experience was important because such organizations will understand better what works and what doesn't. Other interviewees agreed but indicated uncertainty on how important organizational maturity or experience was in isolation. Some respondents argued that, less mature or less experienced organizations could collaborate with more matured organizations to deliver sustainable construction projects. For instance an interviewee 3 responded as below;

*"I'm not certain there is a connection here, there might be. Sustainable project delivery requires improved collaborative work methods and a by-product of working this way is likely to potentially improved organizational learning"*

To add to the above, interviewee 4 simply put it by saying;

*"Not very important but some level of organizational maturity or experience is required to fully engage in a meaning learning that will help deliver sustainable construction project"*

Findings from the above data collection and discussion support the need to explore this area of research further, as little has been written on the link between organizational learning and sustainability in the construction industry. These findings

are relevant to the study and justify the need to move from exploring the current situation and collect more evidence to actually ascertain the current state of the art.

## **CONCLUSIONS**

Organizational learning has been identified in the literature reviewed as the key to organizational survival and prosperity. Sustainability is currently at the core of the construction industry's practices because of its high economic significance and strong environmental and social impacts. Sustainability is now a criteria for all UK public sector procurement and a project criteria for all publicly funded housing projects. Construction organizations are required to demonstrate the ability to deliver and tender for works as demand for sustainable services increases.

Organizational learning methods in the construction industry such as post-project review and post-occupancy evaluation focus on technical issues and do not review completed projects against the triple-bottom line of sustainability namely; environmental, social and economical impact. It is argued therefore that, it is essential that construction organisations engage in organizational learning methods to embrace sustainability.

Data from interviews conducted with experts from the field of built environment, support the need to incorporate sustainability into organizational learning methods in the construction industry in order to survive in this current business climate. This review therefore provides a strong basis for carrying out the proposed on-going PhD research which will attempt to explore the link between organizational learning and sustainability.

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# THE SPATIAL DYNAMICS OF CEMENT MANUFACTURING AND MARKETING IN NIGERIA

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Shelter is a basic necessity of life as man needs to rest his head after a tedious day's work. Shelter is of topmost priority to any man, no matter the size of the accommodation (Clement, 2007). In the provision of this shelter, cement is a major input. Over the years, the nation had witnessed challenges in the cement industry among which are scarcity and high price with resultant high cost of construction and astronomical rents in our cities, usually beyond the reach of the average Nigerian. The pollution of the local environment that houses the cement industries is another challenge of the industry. The global community is concerned with growing levels of pollution due to cement manufacture. Burning of fossil fuels is the cement industry's main energy source and this has led to a large volume of CO<sub>2</sub> emissions in the atmosphere. The global industry is said to account for over 5% of world carbon dioxide emissions (Wikipedia, 2008). In addition, farm land and roof of the buildings of the local environment are usually adversely affected by pollution. In attempt to analyse the main problems of the cement industry in Nigeria with a view to achieving adequate supply of the product with minimal damage to the environment; the pertinent issues are- what are the factors responsible for the low production capacity despite availability of raw material in Nigeria? What are the causes of the high and fluctuating prices of cement? And what are the alternative production strategies that are environment friendly? These are the research problems to which this work tends to provide solutions.

Keywords: cement, manufacturing, marketing, Nigeria.

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# TOWARDS IMPROVING PROCUREMENT OF BUILT INFRASTRUCTURE IN NIGERIA: AN EVALUATION OF THE ‘WARD HEALTH SYSTEM’ STRATEGY IN PRIMARY HEALTHCARE SECTOR

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Procurement is an important process for realising projects and programmes. In the infrastructure sector, it determines the overall framework and structure of responsibilities and authorities for guiding the participants within the development process, and is considered as the key to performance improvement. The aim of this paper is to evaluate the planning and implementation of the ‘Ward Health System’ (WHS) strategy used for procuring primary healthcare (PHC) facilities in Nigeria. The ‘Ward Health System’ is an initiative aimed at facilitating the provision of sustainable and integrated PHC services by revitalising the principle of community co-ownership and co-management of PHC facilities. The evaluation involved semi-structured interviews with twelve people vis-à-vis the on-going reforms in procurement in general and specifically within the health sector in Nigeria. The investigation indicates that the planning and implementation of WHS lacks focus, impact and sustainability. Amongst other things, the evaluation revealed ineffective involvement of the diverse stakeholder groups that would have enabled robust elicitation and understanding of their requirements, strengthening of accountability framework and effective harnessing of private sectors’ managerial and property management expertise to provide quality and sustainable PHC facilities. Although the interviewees questioned the applicability of the concept of community co-ownership or co-management of public facilities, they affirmed the importance of engaging with wide groups of stakeholders to achieve the objectives of PHC philosophy. The investigation subsequently identified the essential areas in which communities can add value to facilitate the satisfaction of the unique requirements of the diverse members of host communities, thereby encouraging effective participation in the management of the completed PHC facilities.

Keywords: primary health care, Ward Health System, procurement, Nigeria.

## INTRODUCTION

‘Procurement’ has become an important process for realising projects and programmes, including those related to construction, and the nature of its scope is increasingly changing and expanding. It determines the overall framework and structure of responsibilities and authorities for guiding the participants within the construction process (Love et al., 1998), and is considered as the key to performance improvement in the construction industry (Ofori, 2006). According to The United Nation Commission on International Trade Law UNCITRAL (1994), procurement is “the process used for the acquisition of goods, works and related services (i.e.

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transport, insurance, installation, training, maintenance and other similar services) required in the execution of a project, excluding consultancy services”. By extension to construction, the UNCITRAL definition suggests procurement is a process of acquiring the inputs (resources) required to deliver a finished facility. In general, McDermott (2006) maintained that the scope of procurement should encompass not only the method used to design and construct a facility but also the cultural, managerial, economic, environmental and political issues raised by the implementation of the procurement process. Therefore, procurement encompasses all the activities involved in the whole-life cycle process of acquiring goods, services or works.

The Federal Government of Nigeria (FGN), through the National Primary Health Care Development Agency (NPHCDA), introduced the Ward Health System (WHS) in 2001. The initiative is aimed at facilitating the provision of sustainable and integrated PHC services by revitalising the principle of community co-ownership and co-management of PHC facilities. In addition, although the FGN has also shown considerable interest in attracting the private sector to boost investment and efficiency in the healthcare sector (National Planning Commission (NPC), 2004; Federal Ministry of Health (FMOH), 2004b), it has not formulated appropriate strategies towards actualising that desire (Ibrahim and Price, 2006a). To date, the extent to which the WHS initiative has achieved its objectives remains abysmal and mixed, and a strong case for further re-examination of its structure, process and function, including its overall place in the PHC subsystem has been made by Nwakoby (2004), (Uzochukwu et al., 2003), (Uzochukwu et al., 2004a) and (Uzochukwu et al., 2004b). There has also been an increasing debate for the involvement of communities, private and not-for-profit sectors in the procurement of PHC facilities in a way that will not fundamentally change the welfare nature of healthcare philosophy. Accordingly, this paper aims at evaluating the planning and implementation of the WHS with a view to recommending a more sustainable procurement strategy that will facilitate the attainment of the goals of the initiative.

## **PROCUREMENT OF PHC FACILITIES IN NIGERIA**

Prior to 1991, the organisation of PHC services was such that each Local Government Area (LGA) had a comprehensive health centre (CHC) serving as a referral centre for four primary health centre (PrHC) and with each PrHC serving as a referral centre for five clinics. In 1991, the organisation was modified with a recommendation that each village should have a health post, a group of villages to have a clinic, each district to have a PrHC while each LGA was to have a CHC.

The NPHCDA, set up through Decree 29 of 1992, announced the WHS in 2001 to replace the old district system (NPHCDA, 2004). The WHS scheme was initially targeted at constructing 200 Model PHC centres in selected wards across the six geopolitical zones of Nigeria (NPHCDA, 2001). However, further approval was granted to provide a total of 740 Model PHC facilities targeted at providing access to basic health services for 15 million Nigerians. While this target is insignificant in itself, the extent to which the scheme is achieving its objectives remains abysmal and mixed, and a strong case for further re-examination of its structure, process and function, including its overall place in the PHC subsystem has been made by Nwakoby (2004), Uzochukwu et al. (2003; 2004a; 2004b). According to NPHCDA (2004), the objectives of WHS are to:

- facilitate provision of integrated PHC services;

- provide opportunity for NPHCDA to mobilise political support for PHC; and
- revitalise the principle of community ownership and co-management of the facilities.

### WHS procurement process

The procurement process of the WHS is represented below in Figure 1. Under the scheme, a consortium of design consultants were commissioned by the NPHCDA to prepare a prototype design and tender documents for use across the country, and prospective contractors compete for the projects in open competition on a site-by-site basis so that local conditions and peculiarities are highlighted in each package. The design consultants alongside the representatives of the NPHCDA supervise the successful contractors on all the sites.

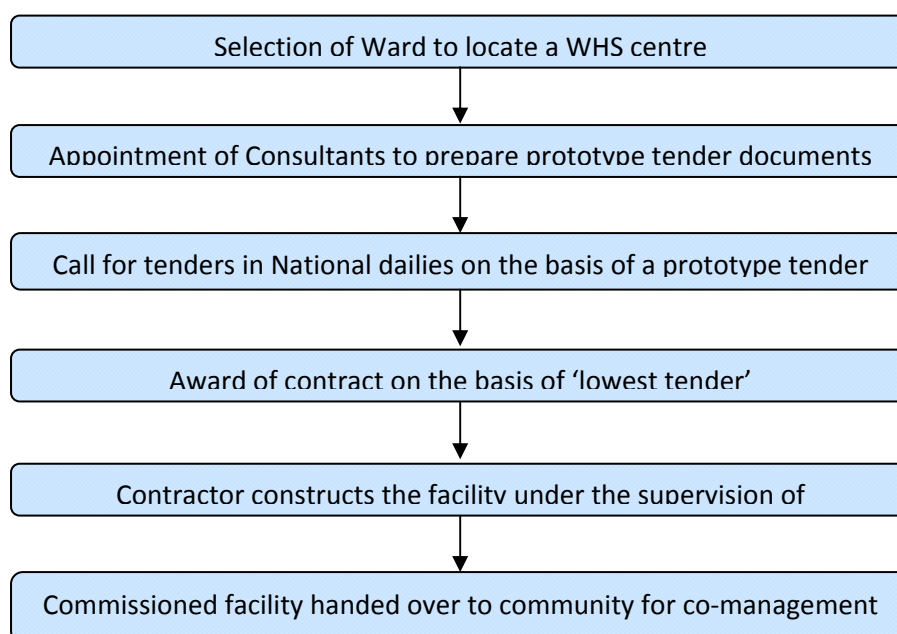


Figure 1: WHS procurement process

After completion, each project is expected to be:

- equipped with clinical facilities worth N5 million (US\$ 40,000);
- equipped with essential drugs, for the value N500,000.00 (US\$ 4,000), for the treatment of common diseases such as Malaria, Diarrhoea and other services like Family Planning, Pre and Post Natal, children and adolescent care; and
- the sum of N1.3 million (US\$ 10,400) (in cash) is provided for the implementation of community-based PHC work plan.

Each completed Model PHC facility is subsequently handed over to the host Ward Development Committee (WDC) to implement community co-ownership work plan. However, these sums have been criticised to be inadequate and the work plan is both scanty and unsystematic, and hence the concept can hardly be sustainable (Ibrahim and Price, 2006a). To date, the extent to which the WHS scheme has achieved its objectives remains abysmal and mixed, and a strong case for further re-examination of its structure, process and function, including its overall place in the PHC subsystem has been made by Nwakoby (2004), (Uzochukwu et al., 2003), (Uzochukwu et al.,

2004a) and (Uzochukwu et al., 2004b). In addition, there has been an increasing debate for the involvement of communities, private and not-for-profit sectors in a way that will not fundamentally change the welfare nature of healthcare philosophy.

## RESEARCH METHODS

The semi-structured type of interview was used in preference to structured or unstructured interviews for this research to enable the researcher probe for further insights and clarification while maintaining some structure in the views collected. The interviews focussed on assessing the achievement of the government targets in the on-going procurement reform in terms of maximising competition, according fair treatment to suppliers and contractors bidding for and awarded public projects and enhancing transparency and objectivity in the procurement process as enshrined in the UNCITRAL Model Law on the Procurement of Goods, Construction and Services.

The characteristics of the interviewees in terms of their background profession, organisation and rank are shown in Table 1. Of the twelve interviewees, four were from the public sector, six were from private organisations whereas the remaining two were from universities. The diversity in the backgrounds of the interviewees provided the opportunity for wide range of views. Ten of the interviewees were directly affiliated with the WHS whereas the two from academia had no direct involvement in any of the schemes but have extensive research experience in public health issues in Nigeria, and one is the Founder/Chief Executive of a healthcare non-governmental organisation (NGO). The blend of interviewees provided a holistic view as it covers at least five principal stakeholder groups: public sector, consultants, contractors, academics and civil society.

Table 1: Interviewee details

S/No	Rank	Background profession	Organisation
1	Project Director	Architect	NPHCDA
2	Senior Quantity Surveyor	Quantity Surveyor	NPHCDA
3	Deputy Director of Primary Care	Human Medicine	FMOH
4	Assistant Director (Planning and Research)	Business Administration	FMOH
5	Managing Director	Civil Engineering	Contractor A
6	General Manager	Civil Engineering	Contractor B
7	Assistant General Manager (Operations)	Building	Contractor C
8	Director (Contracts)	Quantity Surveyor	Contractor D
9	Managing Partner	Architect	Consultant A
10	Associate Partner	Quantity Surveyor	Consultant B
11	Professor	Community Medicine	University/NGO
12	Senior Lecturer	Public Health	University

## INTERVIEW RESULTS AND DISCUSSIONS

In analysing the interviews using the constant comparative analysis principles, the opinions of the participants have been homogenised but where necessary, the opinion of a specific interviewee or group of interviewees are highlighted.

### Planning of the WHS procurement

#### Healthcare system

Although inter-sectoral collaboration has been identified as one of the key pillars of PHC, the interviews revealed that neither the FMOH nor the NPHCDA has established any effective working relationships with other relevant Federal Ministries such as: Agriculture; Education; Science and Technology; Water Resources; Housing; Works; Transport; and Environment. As with the Federal level, the situation at the SMOHs and LGHDs were noted to be the same. It was further established that there is no sense of cohesion, consultation and cooperation between the LGHDs, SMOHs and the FMOH because of the federal system of governance. This has had severe effect on the referral system, especially between PHC and other levels of healthcare. The public sector interviewees noted that the SGs and LGAs perceive the National Health Council which meets once a year for a week as a waste of time and a “talk-shop” where it is alleged that the FMOH tries to get them to merely rubber-stamp decisions already taken.

The investigations also established that there is currently no clear policy that enables the FMOH to monitor progress towards the goals it sets and thereby making them adequately accountable for the health of the nation. In addition, the interviewees also noted that the information system in place is ineffective and fragmented, and that information from the private sector is not being captured, thus making comprehensive health planning difficult. Within the PHC implementing agency (NPHCDA), the interviewees lamented the unclear delineation of responsibilities between PHC policy issues and the construction-related responsibilities. Currently, emphasis is on health-related policy issues and no effort has been made to recruit competent personnel to handle the procurement and sustenance of the PHC facilities being built under the WHS scheme.

In terms of managerial accountability, the interviewees noted that one of the biggest constraints of the ongoing reform programme remains the rigidity of the civil service. For example, the FMOH does not recruit some categories of staff on the Ministry's payroll and this leads to little accountability. The interviewees also described the annual budget preparation exercise by the Ministry as a “ritual” characterised by over-expenditure on what they termed ‘irrelevant issues’. In addition, the interviewees noted that the existing organisational structure as well as communication and reporting relationships within the healthcare system is complex and has grown out of so many obtuse “needs” that the best approach to reform may be to start afresh and plan the system from the beginning. Furthermore, the interviewees noted that the LGAs have been incapacitated in implementing PHC effectively because of inadequate resources from the federation account and the frequent hostile relationships typically related to withholding of funds by the SGs and FG.

The interviewees noted that even the National Health Act being deliberated upon by the National Assembly may not achieve much efficiency gains in the system because of poor engagement with the diverse stakeholders of the health sector during the

preparation of the draft Bill. Besides, the redefined roles and responsibilities for essential public health functions for each of the three tiers of government (and their agencies) may not yield any improvements without a more rational basis for distribution of national revenues vis-à-vis the assigned responsibilities and supported with appropriate structural and accountability mechanisms.

### **Community involvement**

The interviewees argued that the success of any scheme like the WHS, which has one of its central objectives as the promotion of community co-ownership of the completed facilities, is very dependent on high level of engagement with the diverse groups within each community. They also attested to the strong influence on, and diversity of, cultural values and attitudes of the different cultural groupings in Nigeria. The benefits of involving members of the communities were outlined as:

- development and strengthening of community voice in participating in decision making processes and in demanding accountability from the service providers;
- empowering communities in building a common vision, a sense of belonging, positive identity where diversity is valued, and enhanced knowledge and awareness of personal obligation to better health as well as providing them with quality information on health;
- wealth creation activities, such as local job creation, will directly bring increased income and improved health within the local community;
- ensuring that local communities are in a position to influence the ‘what’ and ‘how’ questions related to service delivery and, where appropriate, participate in service delivery and planning for the future; and
- increased confidence and capacity of individuals and small groups to get involved in activities and build mutually supportive networks that hold communities together.

The interviewees noted that the low level of community involvement has resulted in feelings of isolation from decision-making and ownership arrangements as well as missed opportunities in the potential use of traditional communication systems in eliciting and understanding the communities’ values and their potentials both in terms of skills and materials resources. In addition, there were no logically thought-out procedures both for the selection of beneficiary communities and the specific project sites within the selected wards. Although the public sector interviewees admitted that the selection of benefiting wards is done nationally largely on the basis of political affiliation, they argued that the choice of specific project sites are normally done in consultation with relevant local government agencies and the community heads. Yet, the other interviewees contend that the site selections are often based on personal or political interests rather than the interests of society as a whole. As a result, many facilities have been reportedly located at places with poor accessibility because those involved in the oft non-transparent process places the satisfaction of their personal interests above the wishes of the community. The interviewees indicated that the host communities often only get to know about the projects when the contractors begin to mobilise their equipment and other resources to the construction sites. Besides, no attention has been paid to integrating the PHC facilities into the neighbourhood by locating them within close proximity of other community facilities and services or

tapping into the strengths of other community services that have impact on promoting health and wellbeing of the people.

The inapplicability of the concept of co-ownership or co-management of facilities that the communities do not truly possess, or have any control of, or responsible for, was also highlighted. Nonetheless, the essential areas in which communities can add value and facilitate the satisfaction of the unique requirements of the diverse members of host communities thereby encouraging their effective participation in the management of the completed PHC facilities were identified as:

- undertaking of research to investigate and understand the dominant preferences, customs, beliefs and values of the communities;
- setting of priorities, decision making, planning and implementation of strategies of specific community needs;
- effective communication through traditional institutions to promote community education on both health and non-health related aspects of PHC philosophy;
- increased capacity of communities to nurture the skills and talents required in making meaningful contribution, particularly behavioural aspects related to health promotion such as smoking, alcohol and nutrition;
- transparent and clear allocation of roles, responsibilities and accountabilities;
- collaborative and partnership working between local organisations from public, private and not-for-profit sectors to aggregate competences and resources; and
- joint identification of risks associated with each project and the potential mitigation measures.

### **Project design**

The investigations revealed that while the idea of a prototype design may be economically sensible, the current design being implemented has limited future-proofing potential as the incorporation of any additional functions at later phases of the facilities' useful lives may not be cost-effective. As a result, the interviewees suggested that the design development process should involve wider consultations with larger stakeholder groups and assessed at strategic points before commencing construction, as well as during and after the construction of the facilities. The interviewees also noted that the lack of stakeholder involvement has resulted in lost opportunities such as:

- designing and defining the most appropriate and economic solution that meets the requirements of all the stakeholders; and
- benefiting from the expertise and skills of contractors and facilities managers that could promote buildability, maintainability and facilitate harmonious working relationships.

The consultants indicated that they: possessed some experience in the design of healthcare premises; were conversant with the implications of the built environment on the healing process and had incorporated those knowledge and expertise in their design solutions. However, the investigations revealed that the design development process was unsystematic and that there was dearth of best practice requirements and

guidelines. For example, only internal evaluation (within the design team) of the design was made and no access or facilities were provided for disabled persons. However, the contractors felt indifferent about the need for any expertise in healthcare premises design and construction and consider the PHC facilities as any other building. The interviewees unanimously called for more systematic method for evaluating the design, construction and operation of the facilities based on international best practices.

## **Bidding and contracting under the WHS scheme**

### **Tendering and contractor selection process**

The investigation revealed that the WHS procurement was designed to comply with the basic tenets of the UNCITRAL Model Procurement Law, particularly the principle that best value is achieved by maximising competition. The interviewees established that the call for tenders for all approved Model PHC wards are generally advertised in at least two national newspapers in addition to the Federal Tender journal as required, and that the qualification and category of contractors expected to bid are normally indicated. It was also established that although the bids are normally opened at the end of the bidding period in the presence of all the bidders (or their representatives), they were not usually covered by press or witnessed by civil society groups as required.

In addition, the interviewees revealed that the call for pre-qualification were often vague and not taken seriously by both the bidders and client organisation. It was also established that the emphases of the pre-qualification questionnaire and the bases for recommending suitable contractor were often tilted towards contractors' current construction workloads, turnover and financial stability while crucial issues such as the contractor's quality rating, managerial/technical capability, method statement, health and safety records, training policies, risk management system and environmental management systems are often disregarded. Besides, the bid evaluation criteria were neither specified in the calls for tender nor in the bidding documents.

In addition, some of the interviewees (contractor) complained that information on the specific project sites that would have helped them in making adequate provision for relevant site conditions and prevent variations and claims after contract award were not indicated in the calls for tender or tender documents. In any case, despite that bidding is done on a site-by-site basis, the contracts are awarded to the lowest bidders as recommended by the UNCITRAL procurement law but at the same price (consultant estimate) nationwide. As a result, the investigations revealed that a number of technical hitches are being encountered in the forms of variation claims, contractual difficulties and delayed completions.

### **Contract strategy**

The investigations established the traditional design-bid-build philosophy adopted for the WHS as highly adversarial, inappropriate and inflexible. The interviewees acknowledged that the contract strategy, based on the Standard Form of Building Contract in Nigeria of 1990 (SFBCN 90), [SFBCN 90 is the Nigerian adapted version of the Joint Contracts Tribunal 1980 edition (JCT 80)] exacerbated the ingrained frictions between the client and contractors, between different members of the design team, and between the designers and contractors in which each party works for, and defends, its own interest regardless of those of others, and were counter-productive. The investigations revealed that considerable time and effort are often spent in dealing with commercial issues and disputes as a result of suspicion that each party tries to



focus on containing losses or transferring risks of failure to others. In addition, because the contractual clauses and specifications used forces the employment of conventional solutions that may have been successfully applied elsewhere, the interviewees confirmed that the experimentation of innovative solutions in providing optimal solutions were precluded.

In demonstrating the inappropriateness of procurement strategy in facilitating effective community co-management of the completed PHC facilities, the interviewees queried how can people who did not partake in the planning and implementation of a facility take effective co-ownership when it is completed. In addition, the interviewees cautioned that the low patronage of local skills and material makes the facilities' maintenance very difficult as soon as the external contractors depart. Besides, the investigations revealed that there were no specific requirements for the attainment of relevant standards such as quality management (in terms of ISO 9001 or any similar standard), environmental management (in terms of ISO 14001 or any similar standard), health and safety (H&S) management (in terms of OHSAS 18001 or any similar standard). Notwithstanding, some of the interviewees revealed that monitoring and enforcement of contract provisions were grossly inadequate. For example, it was established that there was no monitoring of health and safety at project level and reasons adjudged included: contractors do not include the full cost of meeting their health and safety obligations in tenders because of fear of losing contracts to competitors; and workers are fearful of losing their jobs if they complain about unsafe or unhealthy worksites. Yet, many workers are simply unaware of their rights.

Accordingly, the interviewees recommended the adoption of procurement strategies that involve the allocation of responsibilities for construction, operating and maintenance to one party that would imbibe the local patronage concept through employment of local skills, materials and components. In order to mitigate the potential adversity that may arise as a result of including the recommended diverse array of participants, the interviewees suggested the adoption of partnering ethos and the development of long-term relationship-based contracting methods that encourages collaborative working that will aim at meeting the common objectives of all the participants.

### **Project monitoring and governance**

The investigations revealed a fragmented governance structure (illustrated in Figure 5.1) with unclear roles, responsibilities and accountabilities within and between the participating organisations at both national and ward/project levels, the consequences of which include corruption, distorted decision making processes, increased project costs and dissatisfied public.

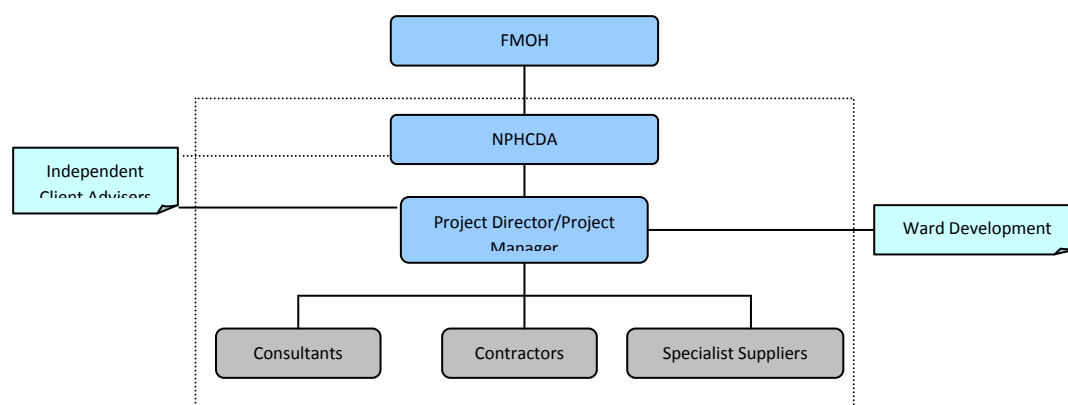


Figure 2: Fragmented governance structure used in WHS procurement

The interviews revealed that the client organisation does not have adequate staff with the necessary skills and competence to effectively monitor the progress of the projects across the country even with the support of the consultants. Of the over 100 employees working for the client organisation, there are only five that have qualifications and experience in procurement and management of construction facilities. The interviewees noted that an average of one supervision visit is typically made to construction sites in a month by the client/consultants' staff, with emphasis skewed towards valuation for contractors' progress payments rather than checking adherence to specifications or the standard/quality of workmanship. However, apart from political constraints, the relatively small size and one-off nature of the projects were adjudged as the possible reasons why more experienced and specialised contractors are not participating in the scheme.

Though to a much reduced magnitude compared to the past, the interviewees noted that corruption is still prevalent throughout the project life cycles, from identification of the project through to the construction stages. It was established that despite the existence of a resident due process team (RDPT) aimed at curbing corruption in public procurement. Some of the interviewees (contractors) revealed that there were instances where public officers directly demanded bribes, or frustrated their progress payments. The ineffectiveness of the RDPT intervention was blamed on the detachment of the members of the team from the operational activities at the project sites. Contractors also complained about instances where project progress were retarded because of delayed payments and generally noted that no interest payments have ever been made to them as required. As a result, contractors have resorted to cutting costs through use of sub-standard materials or taking other shortcuts that have adverse effect on the quality of the completed facilities. Other tactics commonly used by the successful bidders include cutting back on labour costs by pushing down staff wages, hiring casual workers and failure to meet contractual requirements for ensuring the health, safety and welfare of the workers.

## CONCLUSIONS

This paper has presented the results of the evaluation into the planning and implementation of WHS procurement system in Nigerian in attaining the envisaged objectives of PHC philosophy. The evaluation involved semi-structured interviews with twelve people vis-à-vis the on-going procurement and health sector reforms in Nigeria. The investigations indicated that the planning and implementation of on-going strategies lack focus, impact and sustainability. Amongst other things, the evaluation revealed ineffective involvement of the diverse stakeholder groups that

would have enabled robust elicitation and understanding of their requirements, strengthening of accountability framework and effective harnessing of private sectors' managerial and property management expertise to provide quality and sustainable PHC facilities.

Although the interviewees questioned the applicability of the concept of community co-ownership or co-management of public facilities, they affirmed the importance of engaging with wide groups of stakeholders to achieve the objectives of PHC philosophy. The investigations subsequently identified the essential areas in which communities can add value to facilitate the satisfaction of the unique requirements of the diverse members of host communities thereby encouraging their effective participation in the management of the completed PHC facilities.

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# UNDERSTANDING THE CHALLENGES OF WOOD FUEL USAGE IN SUB-SAHARAN AFRICA ON THE ENVIRONMENT

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Almost all African countries still rely on wood to meet basic energy needs. Wood fuel use accounts for 90 to 98 % of residential energy consumption in most of sub-Saharan Africa. Wood fuel can be used for cooking and heating, and occasionally for fueling steam engines and steam turbines that generate electricity. The burning of wood is currently the largest use of energy derived from a solid fuel biomass. From materials consulted the result indicates that of 13 sub-Saharan African countries investigated in 1994, 76 percent of the domestic energy demand was wood fuel, electricity 9 percent, kerosene 8 percent and gas 7 percent. It also shows that wood fuel usage increased from 513.6 million m<sup>3</sup> in 1990 to 622.5 million m<sup>3</sup> in 19994. The major environmental challenges are air pollution (particulate) and deforestation. In conclusion deforestation has as its children land degradation, biodiversity loss and desertification and the way forward is for government to sensitize and offer alternative energy source to its citizens.

Keywords: energy, environment, sub-Saharan Africa, wood fuel.

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# VALUE MANAGEMENT: HOW ADOPTABLE IS IT IN THE NIGERIAN CONSTRUCTION INDUSTRY?

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The Nigerian Construction Industry (NCI) is constantly criticised for its ailing performance as evident in the rising spate of dissatisfaction among its clients and stakeholders. Recently the Federal Government of Nigeria (FGN) stipulate that procurement of public assets and services must be through the '*application of value-for-money (V<sub>f</sub>M) standards and practices*', as a way of improving service delivery. Value Management (VM) seems an accepted approach for achieving V<sub>f</sub>M globally. But how feasible is its adoption in NCI? This paper studied the adoptability of the VM in NCI by identifying its determinants particularly at early stages of building projects. The study adopts a theoretical approach towards identifying the dissonances between procurement practice in NCI and that required for adopting the VM. Drawing from theoretical considerations, 26 characteristics describing the planning and contract strategy stages of the NCI were arrived at. Four aspects were further identified for classifying VM requirements namely Environment, People, Issues/Information and Process. The dissonances of Environment and People were generally '*low*' or '*moderate*' while those for Issues and Process are either '*high*' or '*very high*'. These considerations leads to the theoretical conclusion that, given the current nature of NCI, VM is not adoptable. Although, subject to empirical validation, VM can be adopted if the NCI pursue measures at engaging stakeholders on team basis, implementing construction programmes that are effective; exploring the concept of '*partnering*' to reduce the fragmentations in project values; strengthening client organisation to provide strong leadership with a high degree of commitment and involvement, amongst others.

Keywords: Nigeria, procurement, value management.

## INTRODUCTION

The Nigerian construction industry (NCI) can easily be described as the '*sleeping giant*' within its continental neighbourhood in terms of service delivery and satisfying the needs of its clients. It is a '*Giant*' in that since construction industries worldwide provides as much as 5% employment opportunity of a nation's population (World Bank, 1991; Hillebrandt, 1984; 2000), NCI is responsible for employing approximately 8 million people, having a population of approximately 140million. This represents approximately 20% of Nigeria's workforce (National Bureau of Statistics, 2006), perhaps, making it the largest employer of construction labour in Africa. Despite its massiveness, NCI has severally been credited with lack of capacity to deliver. For instance there have been several reports of: *rush nature of project implementation* (Mosaku, 1984; Musa, 1990), *inadequate planning and budgetary provisions* (Elinwa and Buba, 1993), *projects executed at higher sums* (Giwa, 1988; Okuwoga, 1998),

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*inefficient and poor service delivery* (Aibinu and Jagboro, 2002), *abandoned or non-functional facilities and collapsed building* (Wahab, 2006). The perennial nature of these traits creates dissatisfaction amongst clients (Omole, 2000; Ajator, 2004).

The NCI is described as '*sleeping*' because nations with similar developmental needs during the early 70s e.g. Kenya, Ghana, South Africa (Bowen et al., 2007), Malaysia, Japan, Korea (Cheah and Ting, 2005), Saudi Arabia (Al-Yami and Price, 2006; Alalshikh and Male, 2009) have long realised the need to improve their service delivery capacities and have indeed (at some point) embrace the '*Value for Money*' ( $V_fM$ ) concept through *Value Management* (VM). Despite the advocacies for NCI to improve on her service delivery capacities by bettering value for public funds in construction projects, through VM (Omole, 2000; Ajator, 2004), this is yet to be achieved. Oke and Ogunsemi (2009) observed that '*Value management has not been fully embraced in the Nigerian construction industry as only very few number of value management workshops have been organised so far according to investigation and the workshops were even concluded prematurely*'. However, the Federal Government of Nigeria (FGN) had only recently decreed the enforcement of '*Application of value-for-money standards and practices for the procurement of public assets and services*' (Federal Republic of Nigeria, 2007). Ibrahim (2007) reviewed attempts by FGN to improve procurement performance, amongst which are: FGN commissioning Nigerian Private Sector in collaboration with World Bank to review the public financial system and general procurement-related activities in 1999; the issuance of government circular titled '*New Policy Guidelines for Procurement and Award of Contracts in Government Ministries/Parastatals*' in 2000; and establishment of the Budget Monitoring and Price Intelligence Unit, to act as the clearing house for all FG procurement in 2003.

Experiences from UK during the 1990s (Kelly, Morledge, and Wilkinson, 2002) indicate significant changes in response to adopting newer procurement strategies aimed at satisfying the HM Treasury directives on value for money. This is evident in the spate of construction reports which appeared e.g. Latham in 1994; Technology Foresight 1995; CIB published 12 reports during 1996 – 97; and Egan in 1998. All these culminated to the eventual adoption of VM during the mid 1990s. Kelly and Male (1999) gave examples of best value initiatives in the UK public sector e.g. the *National Health Service Trust projects* and the *Department of the Environment, Transport and the Regions Housing Programme*. Adoption of VM towards improving  $V_fM$ , brought about substantial savings. For instance *improved productivity based on more effective programme and streamlined procurement* resulted in a 4% annual savings in capital costs, *collaborative working approaches* 6%, while *savings in the whole life costs of built assets*, results in a potentially significant saving of 5% of operating cost (NAO, 2005).

Drawing from the above background, this paper hypothesise that current procurement practices in NCI is responsible for the non take-off of VM, years after its recognition as a potential driver for the improvement of value for money for public procurements in construction. In line therefore, the paper examines the adoptability of VM in NCI. Several VM-related researches in construction have been reported, particularly those relating to its successful implementation (Male, 1998; Chua et al., 1999; Shen and Liu, 2003). This paper's arguments differs from the mainstream in that it focuses on issues that must be available for VM to be undertake i.e. the *requirements 'for' VM* rather than on factors that guarantees VM success i.e. *requirements 'of' VM*.



## STUDY METHODS

The paper adopts a theoretical approach to expound theories of VM, and its requirements. Using evidences of current procurement practices in NCI, the paper further establishes the dissonance between practices and that required for adopting VM. In other to do this, the characteristics of the procurement strategy as shown in Table 1 were juxtaposed against each of the requirements for VM. For instance, *working relationship* requirement under 'Environment' category requires that the **environment** under which VM can be adopted must be such that would engender excellent and integrated team-based working relationship amongst those who will part-take in the VM exercise. All the characters ranging from C1 to C26 were scanned through to see whether they relate to each of the various requirements. Where a relationship is evident, determined by heuristic reasoning, that character is assigned to the requirement under consideration in a 'many-to-many' fashion. For example, *work relationship* requirement is influenced by C1, C2, C5 etc while C2 influences the following requirements *work relationship*, *team spirit*, *decision-making* etc.

Furthermore, to determine the extent of dissonance between the requirements for VM and practices within NCI, a weighting system was used to quantitatively contextualise the dissonances in terms of a four point descriptive scale. A very simple approach of quantification was considered, i.e. dividing the numbers of characteristics associated to each requirement by the total number of characters i.e. 26 and then multiplying the result by 100. For instance where a requirement is associated with 7 characteristics, it is assigned the value 27% i.e. 7 divided by 26 multiply by 100. The assumption is that each of the characteristics is equally weighted and thus affects the procurement strategy in equal magnitude). This however is a potential limitation of the paper. The value so determined is then used to contextualise dissonance in terms of 'None' i.e. 0 – 10%, 'Low' 10 – 20%, 'Moderate' 20 – 40%, 'High' 40 – 70%, and 'Extremely high' 70 – 100%. The result of this exercise is shown in Table 2.

## VALUE FOR MONEY AND VALUE MANAGEMENT

The maxim '*the customer is king*' has propelled industries dealing with the production of customer-focused services and/or products, to concentrate on the concept of *value for money* as a means of achieving the ultimate purpose of doing business – creating and growing stakeholders' wealth through customer retention by improving on customers' satisfaction. Office of Government Commerce (OGC) (2003) defines value-for-money as '*the optimum combination of whole-life cost and quality to meet the user's requirement*'. User's requirements can be viewed in terms of functional requirements, intrinsic worth, exchange and esteem value (Standing, 1999). From Standing's adjectival consideration of the concept of value and OGC's definition of  $V_fM$ , two paradigms emerge – *process* (from the latter) and *product* (from the former). Hence '*satisfaction*' in construction is achieved when *the process that delivers the product operates optimally (as should be the case within the supply chain of procurement) and that the user is satisfied with the end product (the demand side)*. At present, several methodologies have evolved in achieving and enhancing  $V_fM$  in construction, but VM is receiving particular attention due to its added advantage of imparting on strategic decisions right from the earliest stages of project cycle (Male et al., 1998; Woodhead and Downs, 2001; Kelly, Morledge and Wilkinson, 2002).

## Definition of value management

Male et al (1998) defines VM as ‘a proactive, creative, problem-solving or problem-seeking service which maximises the functional value of a project by managing its development from concept to use. The process uses structured, team-oriented exercises that make and appraise existing or generated solutions to a problem by reference to the value requirements of the client’. Another definition is that given by National Audit Office (NAO, 2005) thus: ‘An Approach which seeks to identify a series of desired outcomes; the benefits that will lead to those outcomes and the most cost-effective way of delivering them’. Al-Yami and Price (2006) assert that VM is increasingly seen as the approach to delineate the whole process of improving a project value from concept to operation. Shen and Liu (2003) opines that VM is an effective methodology for achieving “best value for money” for clients and that many countries around the world have observed the successful application of VM in the construction industry. There has been continuous call for the use of VM in public procurements even in economies challenged by its requirements. For instance, Salvatierra, Pasquire and Thorpe (2008) advocates the incorporation of the concept of value through exploration of Value Management and Lean Thinking, in addressing project objectives aimed at satisfying the real housing needs of low income people in Chile. This, it is believed, will add value to the housing delivery process for delivering satisfactory solutions.

## Requirements for value management

Studies on VM have hitherto concentrated on factors affecting their successful implementation. A review of these studies revealed factors that can also affect the need to implement VM termed as ‘*requirements for VM*’ i.e. factors that must be satisfied before VM can be implemented. This should be viewed differently from the factors that must be met to ensure successful outcome from a VM study – ‘*requirements of VM*’. Some of the broad-based factors identified in literature are: *available construction programmes, nature of public sector construction client; basis for design and decision-making, working relationships, procurement and contracting strategies* (NAO, 2005); *relationship between different partners in terms of communication, working relationships, ownership and commitment, and team spirit* (Iu, 2007 cited in Kumaraswamy et al., 2008). Others include: *defining and pursuing value in terms of value for money, return on investments and reputation; developing ‘network value’ in terms of cost, time, safety and security, good governance, environmental impact, quality and function, legacy, profit, contribution margin, and enhanced business opportunity* (Kumaraswamy et al., 2008); and *profiling the client value system in terms of time, capital cost, operating cost, environment, exchange, flexibility, esteem, comfort and politics* (Yu et al., 2006). Shen and Liu (2005) identified 25 Critical Success Factors for VM in construction out of which 15 were found to be most critical by VM practitioners.

A study of these factors and considerations of the definitions offered above, brings to fore four basic aspects under which *requirements for VM* can be looked at, namely: *people, process, issues and environment*. Categorising the aspects based on the definitions, since VM is an *approach* which should be *proactive* and *creative* it therefore requires inputs from ‘*people*’ who can adequately manage the *approach*, with adequate and required knowledge and experience to deliver on *proactivity* and *creativity*. Being a *problem-solving* or *problem seeking* service, VM requires that ‘*issues/information*’ needs to be deliberated upon, which in themselves must possess

certain qualities to qualify for consideration. Furthermore, '*problem-solving*' and '*make and appraise existing or generated solutions to a problem*', will require the use of some form of '*process*' which will also fulfil the requirements for '*structured, team-oriented exercises*'. The '*environment*' requirement comes into perspective when consideration is given to the need to '*identify a series of desired outcomes*' by adopting a '*proactive, creative, problem-solving/seeking service using structured, team-oriented exercises*'. The above conception formed the basis of theoretically establishing the adoptability of VM in Nigeria (see Table 2).

## PUBLIC PROCUREMENTS FOR CONSTRUCTION PROJECTS IN NIGERIA

Procurement of public construction projects in Nigeria is dominantly based on the traditional method i.e. the design-bid-build approach (Ajator, 2004; Ibrahim, 2007). However, there have been evidences of the use of integrated approaches in procuring some public building and infrastructure. For instance, the concept of BOT and PPP/PFI were both popularised by the FGN during the early 2000. The FGN embraced the PPP approach in 2000 to accelerate active involvement of the private sector (NPC, 2004). Application of PPPs in Nigeria are becoming increasingly popular for new and maintenance projects and for the management of existing facilities. Two approaches of PPPs in Nigeria are Joint Venture (JV) and Build Operate Transfer (BOT) used for infrastructural projects e.g. roads, tourism, power generation amongst others (Ibrahim, 2007). For instance, Dada et al., (2006) reports that 85% of PPP projects executed by the Lagos State Government were delivered through either JV or BOT. Abuja Property Development Company (APDC) formerly Abuja Investment and Property Development Company (AIPDC) in 2006 awarded contracts over US\$30billion for various projects e.g. development of district markets using BOT, multi-level car parks; 65km metro-rail line, integrated tourism resorts; technology, sporting and commercial facilities; housing and office developments, shopping malls and community centres amongst others (APDC, 2010).

### Characterisation of procurement strategy in Nigeria

Procurement related researches in the NCI are very scant thus this paper derives evidences from findings of a research work on procurement strategy for provision of facilities for Ward HealthCare Service (WHS) delivery in Nigeria. We have assumed that the findings exemplifies the general characteristics of the NCI since procurement strategies for public projects are regulated by the FGN, irrespective of the sectoral classification e.g. education, transport, health etc. The finding were based on a semi-structured interview based on the FG policy on improving the delivery mechanism of the NCI, titled '*New Policy Guidelines for Procurement and Award of Contracts in Government Ministries/Parastatals*' issue via Circular No F.15775 27<sup>th</sup> June 2000. The findings were categorised into three vital stages of procurement, namely **Planning** consisting of *client-based issues* (in this case Healthcare System), *community involvement* and *project design*; **Bidding and Contracting processes** consisting of *tendering and contractors' selection processes* and *contract strategy*; and **Project Monitoring and Governance**.

Ajator (2004) outlined some of the procurement practices in NCI with reference to the design stage. Though no empirical evidence was provided for the basis of arriving at these practices, they are similar to some of those found in Ibrahim's work. These design practices include: *unduly short construction programme leading to design error, obsolete design concept in the face of changing technologies, misreading of*

*brief/user's requirements, and absence of co-ordination between client and design team.*

Table 1 – Characteristics of Procurement Strategy in Nigeria

No	Character Description
<i>Client Organisation</i>	
C1	Lack of collaboration and poor working relationships with partners
C2	Poor cohesion, consultation and cooperation between coordinating agencies
C3	Lack of clear policies on performance and accountability assessment
C4	Inefficient and fragmented information system
C5	Unclear delineation of organisation and construction project responsibilities
C6	Incompetent personal for handling procurement within organisation's framework
C7	Structure, communication/reporting relationships are complex and ineffective
C8	Incapacitation of the implementation/beneficiary agencies by the funding agencies
C9	frequent hostilities between implementing/beneficiary agencies
C10	Governance structure is fragmented with unclear roles and responsibility guide
<i>Community Involvement</i>	
C11	Low level of community involvement
C12	Absence of logical thought-out procedure for selecting beneficiary communities
C13	Lack of community awareness programme
C14	Non-utilisation of community-based resources and services
<i>Project Design</i>	
C15	Design been implemented have limited future-proofing potentials
C16	Lack of and/or limited scope of consultation with larger stakeholder group
C17	Absence of system for assessing design developments
C18	Design process is unsystematic and lacks best practice requirements and guidelines
<i>Contract Strategy</i>	
C19	The traditional procurement method is adopted
C20	Procurement method is highly adversarial, inappropriate and inflexible
C21	Contract conditions used is found to be counter-productive
C22	Considerable time and efforts are spent on commercial issues and disputes
C23	Innovative solutions are thwarted due to the nature of contractual provisions
C24	Facilities management/maintenance is difficult due to low patronage of local skills
C25	No specific requirements exists for the attainment of standards
C26	Monitoring and enforcement of contract provisions are grossly inadequate

Source: Ibrahim (2007)

Others include *imperfect design information, biased disposition of design team and absence of design expertise, over-designing or incomplete designing*. Below is a summary of research findings as regards conformance of procurement practices for public construction projects in the healthcare sector with the provisions of the *New Policy Guidelines*. This paper only considers and characterised the planning and contract strategy stages as shown in Table 1.

## DISSONANCES BETWEEN REQUIREMENTS FOR VM AND PROCUREMENT PRACTICE IN NIGERIA

This part of the paper discusses compatibility issues in the adoption of VM between its requirements and current procurement practice in Nigeria as shown in Table 2. Only the requirements under the Environment category are reported in this paper. A detailed consideration of the other requirements will feature in another paper.

Table 2 – Requirements for VM Vs Procurement Characteristics of the NCI

Requirements	Required Character	Nigerian character	Dissonances
<i>Environment</i>			
Working Relationship	Excellent, integrated team	C1 2 5 7- 9 20	<i>Moderate</i>
Team Spirit	Collaborative, Creative	C2 3 14	<i>Low</i>
Governance	Good, Integrated	C10 18 25	<i>Low</i>
Decision-making	Whole life Value-based	C2 4 11 12 15-18 25	<i>Moderate</i>
Comfort and Politics		C3 5 6-10 12 18 22 26	<i>Moderate</i>
<i>People</i>			
Public Sector Client	Well focused, capable	C3-6 17 18	<i>Moderate</i>
Ownership and Commitment	Full,	C8-10 11 14	<i>Low</i>
Communication	Excellent, Simple	C1-2 4 7 10 13 16 18 20 25	<i>Moderate</i>
Experience and Knowledge	Adequate, Relevant, Innovative	C4 6 11 14 23 25	<i>Moderate</i>
Personalities and Reputation	Open-minded, Responsive	C6 7	<i>None</i>
<i>Issues/information</i>			
Construction programmes	Effective	C3 7 10 11 15-26	<i>High</i>
Value for money	Clear,	C3 6 7 10 11-18	<i>High</i>
Return on Investment		C3 6 8-14 20 23-26	<i>Moderate</i>
Cost and Time	Clear, definite, complete	C3 6 12 21-25	<i>Moderate</i>
Business Opportunity		C4 6 11 14 20-26	<i>Moderate</i>
Contribution margin and Profit		C3-8 11 14 19-26	<i>High</i>
<i>Process</i>			
Procurement and Contract Strategy	Appropriate, flexible	C3-5 7 11-26	<i>Very High</i>
Quality and Function		C3-4 7 10-25	<i>Very High</i>
Flexibility		C3-5 7 11 15-18 19-23	<i>High</i>
Skills and Techniques	Adequate, Relevant	C1 2 5-7 11 15-18 20-23	<i>High</i>
Logistics	Appropriate, Relevant	C3-7 13 15-18 20 23 25	<i>High</i>
Performance Assessment		C3-6 10-12 15-18 20-21 26	<i>High</i>
Change and Process Management		C1-26	<i>Very High</i>

### Environment requirements vs. procurement practice in NCI

Five requirements were identified under the ‘environment’ category namely *working relationship*, *team spirit*, *governance*, *decision-making* and *conflict and politics*. The dissonances between these requirements and current practice are described as either ‘low’ or ‘moderate’ as shown in Table 2. Dissonances described as ‘low’ signifies that due to smallness of characters associated with a particular requirement, current procurement strategy can accommodate the conditions for the requirement with minimal adjustments using less effort. Where the dissonances are described as

'moderate', adjustments can be made to realign these dissonances in line with requirement conditions but that such adjustment will require great managerial efforts as entrenched in Design-bid-build approach.

### **Working relationship**

Ideal environment for VM must be one that fosters excellent working relationship amongst participants and one that can promote integrated team-based approaches to problem solving. Current procurement practice in the NCI relative to working relationships is characterised thus: there is lack of collaboration and poor working relationships amongst partners; poor cohesion, consultation and cooperation between coordinating agencies. Delineation of organisation and construction project responsibilities are not clearly spelt out; organisation structure, communication/reporting relationships are complex and ineffective; incapacitation of the implementation/beneficiary agencies by the funding agencies; frequent hostilities between implementing/beneficiary agencies; and that the procurement method is highly adversarial, inappropriate and inflexible. Hence, current procurement practice does not support the ideals of VM in terms of working relationship and its dissonances are 'moderate', as shown in Table 2. This is indicative of the nature of incompatibility between VM requirement and current practice, in that while there are evidences of incompatibilities, current procurement practice can still accommodate the requirements of working relationship. Design-bid-build is the predominate procurement approach in use, hence an excellent environment that engages integrated team approach is possible but this will require great deal of management effort to achieve.

### **Team spirit and governance**

VM requires an environment in which teams can work collaboratively and creatively but procurement characteristics in Nigeria indicates that there is a rather poor cohesion, consultation and cooperation between coordinating agencies; lack of clear policies on performance and accountability assessment; and that community-based resources and services are not used. These dissonances are not as severe as that of working relationship as they are considered 'low'. Implicatively, current procurement strategy suffices for team spirit requirements and that this can be corrected for with minimal effort. Requirements for governance is that it should be good and integrated, though this isn't the case in Nigeria which is characterised as having a fragmented structure with unclear roles and responsibility guides; the design process is unsystematic and lacks best practice requirements; and no specific requirement guides for the attainment of standard. Hence governance in project procurement is in sharp contrast with requirements for VM. Having its dissonances described as 'low', minimal modifications to implementation of the design-bid-build approach will attune the dissonances in line with governance requirements for VM.

### **Decision-making**

VM decisions are required to be based on whole life value against the typical '*lowest initial cost*' concept adopted. The dissonances includes poor cohesion, consultation and cooperation between coordinating agencies; insufficient and fragmented information system; low level of community involvement; and the absence of a logical thought-out procedure for selecting beneficiary community. Others includes designs have limited future-proof potentials; lack of consultation with larger stakeholder group; absence of design assessment system; design process is unsystematic and lacks best practice requirements; and that there are no specific requirement guides for the

attainment of standard. These dissonances are described as '*moderate*', which means that they could be re-aligned within procurement strategy in use, again, requiring great efforts in managing the re-alignment process.

## CONCLUSION AND RECOMMENDATIONS

Despite the size of NCI, it is severally criticised for lack of capacity to deliver with a growing rate of dissatisfaction amongst its clients. Recently, the FGN instructed that all public procurement must be executed through the application of value for money standards and practices. Globally, Value Management is a popular candidate for achieving value for money in construction. A review of procurement strategy in NCI suggest that Design-bid-build approach is the dominate method but there are evidences of procurement of public project through PPPs, particularly for infrastructure. Experiences from UK suggests that fundamental changes are required in adopting VM towards achieving and improving value for money, however this is not the case in Nigeria.

Based on the slow take-up of VM in Nigeria, this paper did explore the adoptability of VM in NCI within the hypothesis that a reason for the slowness is due to inherent procurement practices within the industry. To achieve this, requirements for VM were synthesised theoretically and categorised under four major groups namely environment, people, issues and lastly process. In all, 24 requirements for VM are arrive at. Evidences of current construction procurement practice in Nigeria were gleaned from a recent research detailing on procurement strategy for the provision of constructed facilities for Ward HealthCare Service delivery in Nigeria. A total of 26 characteristics were identified. These characteristics were juxtaposed alongside the requirements in a manner reflecting the association of the latter to the former. The extent to which there is a mismatch indicated the dissonances between them which were described either as none, low, moderate, high and very high.

The Environment category consists of five requirements namely working relationship, team spirit, governance, decision-making, and comfort and politics. The dissonances for requirements of this category were found to be either '*low*' or '*moderate*'. For instance, working relationship requires that the environment under which VM can be adopted must be excellent enough to promote integrated team work, but the incidences of the inherent practice e.g. lack of collaboration and poor working relationships amongst partners; poor cohesion, consultation and cooperation between coordinating agencies amongst others, negates this condition. From a theoretical point of view, If, we based the adoptability of VM on requirements within the environment category alone, it becomes justifiable to accept the current procurement practice i.e. design-bid-build approach as a potential vehicle for VM, having '*low*' and '*moderate*' dissonances. However, the success of adopting VM within this approach will require that efforts of NCI should concentrate on exploring ways of improving the environment under which VM can work. This can be done by engaging stakeholders on team basis, developing and implementing construction programmes that are effective, exploring the concept of 'partnering' to reduce the fragmentations in project values. Furthermore, to improve on governance and decision-making within inherent current procurement practice, client organisation must be strengthened to provide strong leadership with a high degree of commitment and involvement; broadening the scope of stakeholder engagement with greatly improve decision-making particularly where such engagement are done at early stages. However, since these findings and conclusions are based on theoretical synthesization, empirical-based approach is thus

recommended to validate the findings of the study so as to offer basis for the generalisation of these outcomes within NCI.

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